Scientific and Technical Journal Namangan Institute of Engineering and Technology

Google Scholar

doi zenodo

SLIB.UZ
Scientific library of Uzbekistan

NamMTI ILMIY-TEXNIKA JURNALI

T a h r i r   h a y ' a t i   a ' z o l a r i :

PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

UDC 677.21.021

ANALYSIS OF LOAD CHANGES IN THE CHAIN DRIVE DURING THE DRYING PROCESS OF COTTON FALLING FROM THE LONGITUDINAL SHELVES OF THE DRUM

SHODMONKULOV ALISHER

Senior teacher of Jizzakh Polytechnic Institute

JAMOLOV RUSTAM

Professor of Jizzakh Polytechnic Institute

YULDASHEV XURSHID

PhD of Jizzakh Polytechnic Institute
Tel.: (+99891) 188-22-29

Abstract:

Objective. The results of a theoretical study of the load change in the developed chain drive with uneven rise and fall of dried raw cotton by longitudinal shelves inside the 2SB-10 drum during the drying process.

Methods. In the process of research, the principles of higher mathematics and theoretical mechanics, special and modern methods of measurement, evaluation, comparison, methods of mathematical statistics and computational mathematics, computer software were used to assess the differential equations.

Results. Differential equations are derived for determining the torque, the required power of the electric motor and for choosing the brand of the chain.

Conclusion. Based on a theoretical study, it can be concluded that the calculated design scheme of a drum dryer with a chain drive made it possible to derive differential equations for determining the torque, the required power of the electric motor and for choosing the chain brand.

Keywords: dryer drum, raw cotton, load, blades, rolling, torque, process, formula.

Introduction. It is known that when the top point of the dryer drum is reached, the raw cotton captured by its blades begins to fall down [1, 2, 3], while the load on the chain tension of the developed chain drive temporarily drops, and when it falls completely down, such a fluctuation in the chain tension does not preferably, to eliminate this effect, the use of a brake mechanism is proposed.

Suppose there is a load of mass m on the blade. It is located in a uniform layer, after which it rises to a height until the friction angle reaches equilibrium. Then the raw cotton will begin to roll down, and gradually.

Methods. We derive formulas for determining the speed and movement of raw cotton when moving along the blades when lifting. To do this, we compose a differential equation (Fig. 1) [4, 5]:

$$m \frac{dv}{dt} = mg \sin \alpha - fmg \cos \alpha \qquad (1)$$

where: m- is the weight of the cargo, kg;

  f - is the coefficient of sliding friction of the load along the plane.

Let us integrate equation (1) twice under the initial conditions
t = 0, v = v0, s = 0 we get:

$$v = \frac{g \sin(\alpha - \varphi)}{\cos \varphi} \qquad (2)$$

$$l_{n\pi} = \frac{g \sin(\alpha - \varphi)}{2 \cos \varphi} t^2 - v_0 t \qquad (3)$$

where: v0 – is the speed of the load at the moment of arrival on the plane, m/s

φ –angle of sliding friction of the load along the plane.

$l_{n\pi}$ – blade length

Analysis of formulas (2) and (3) reveals the following features in the nature of the movement of cargo particles along an inclined plane:

- if <, then the speed of the load while moving along the blade decreases uniformly and eventually becomes equal to 0 at the beginning of the rise,

- if >, then the speed of the particles of the load when moving along the plane increases evenly, in the case of the end of the ascent.
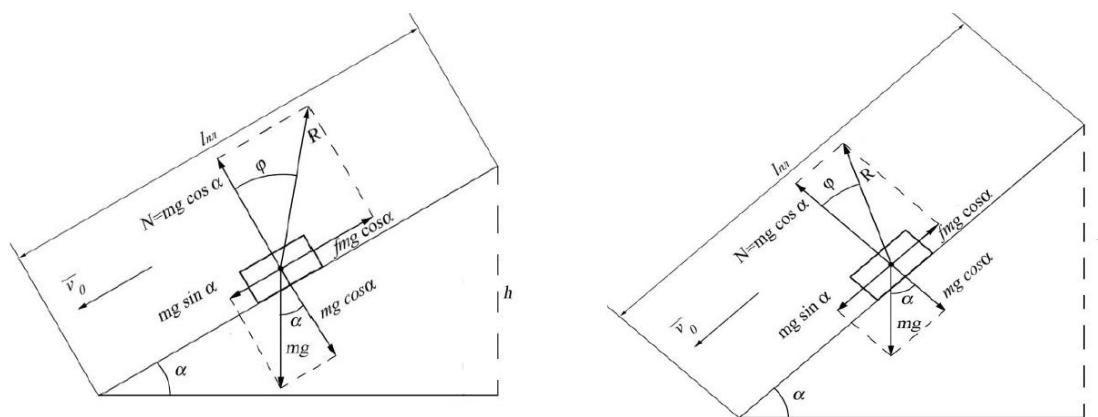
Fig.1. Calculation schemes for determining the speed and movement of raw cotton along the blades of the dryer drum during lifting

Let us denote the speed of the particles of the load at the moment of leaving the plane as *v* out.

From equation (2), assuming v = v out, we determine the time of particle motion along the inclined plane [6]:

$$t_в = \frac{(v_{вых} - v_0) \cos \varphi}{g \sin(\alpha - \varphi)} \qquad (4)$$

Considering that the movement is in the drum, the initial speed will be equal to zero, then (4) will take the following form:

$$t_в = \frac{v_{вых} \cos \varphi}{g \sin(\alpha - \varphi)} \qquad (5)$$

Using equation (2), we find the time of passage of raw cotton if it is at the base of the blade:

$$t_в = \sqrt{\frac{2 l_{n\pi} \cos \varphi}{g \sin(\alpha - \varphi)}} \qquad (6)$$

Results. At what we will change the time, since the angle will change taking into account the rotation of the drum.

Knowing the angular ω velocity of the drum, we can write (6) in the following form.

$$t_{e} = \sqrt{\frac{2l_{nn} \cos\varphi}{g \sin(\omega t - \varphi)}} \qquad (7)$$

And since a change in angle leads to a change in time, so the speed will change.

$$v = \frac{g \sin(\omega t - \varphi)}{\cos\varphi} \qquad (8)$$

The slipping of the total mass of raw cotton from the blade will occur in the time:

$$t_{e} = \sqrt{\frac{2dx \cos\varphi}{g \sin(\omega t_{e} - \varphi)}} \qquad (9)$$

$$dt_{e}^{2} \sin(\omega dt_{e} - \varphi) = \frac{2dx \cos\varphi}{g}$$

We integrate both parts of the equation and get the following:

$$\frac{\cos(\varphi - \omega t)(\omega^{2} t^{2} - 2 + 2\omega t)}{\omega^{3}} = \frac{2l_{nn} \cos\varphi}{g} \qquad (10)$$

So for $\varphi - \omega t$ the boundary conditions is comparable to 0, $\cos(\varphi - \omega t)$ then we equate the values to 1 in this case, equation (10) can be represented as:

$$\omega^{2} t^{2} + 2\omega t - \frac{2l_{nn} \cos\varphi\omega^{3}}{g} - 2 = 0 \qquad (11)$$

Solving equation (11) we obtain the following

$$t_{1,2} = \frac{-\omega \pm \omega\sqrt{g + 4l_{nn} \cos\varphi\omega^{3}}}{\omega^{2}\sqrt{g}}$$

Since the angular velocity cannot be negative, and the time cannot be less than zero, we leave only one root of the equation

$$t = \frac{-\omega + \omega\sqrt{g + 4l_{nn} \cos\varphi\omega^{3}}}{\omega^{2}\sqrt{g}} \qquad (12)$$

Having the time of slipping of raw cotton from the blade and its finished speed during the tearing, one can find the regularity of the dynamics of the chain tension

The tension of the chain at full load until the cotton falls off will be equal to

$$F_{\text{натя}} = \frac{2M_{\text{кр}}}{D_{\text{цепи}}} \qquad (13)$$

When raw cotton falls, the tension will change according to the following formula

$$F_{\text{натяж}} = F_{\text{натяж}} - F(t) \qquad (14)$$

where: $F(t)$ - changes in force depending on the rolling of the load

And, in turn, from the torque, which is also expressed through the function

$$M_{\text{кр}} = M_{\text{кр}} - M(t) \qquad (15)$$

find the function of changing the moment in time. As already mentioned, it will change from a change in the mass on the blades.

Let us assume that the blades are completely filled and a layer of raw cotton lies on them in an even layer.

Then the total mass x / s will be equal to

$$m = L * h * L_{\text{бараб}} * \rho \qquad (16)$$

Then the moment affected by the rise of raw cotton will be equal to

$$M_0 = \left(R - \frac{L}{2} \right) * m * g \qquad (17)$$

Let's select a small section along the width of the blade, which moves depending on the angle that the bar occupies during the rise (8).

Let us now introduce the initial position at which the raw cotton begins to mix, let this be the angle, then equation (8) can be written in the following form for the selected area:

$$v(t) = \frac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi} \qquad (18)$$

The mass will change as the raw cotton increases according to the following relationship

$$L(t) = L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi} t \qquad (19)$$

Substituting formula (19) into (16) we obtain the following

$$m = \left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi} t \right) t * h * L_{бараб} * \rho \qquad (20)$$

To calculate the torque, it must be taken into account that the point of application of the force will also change according to the following law [6,7]:

$$L(t) = \left(R - \frac{(L - v(t)t)}{2} \right) \qquad (21)$$

Discussions. We substitute the obtained data into formula (15) and obtain the following dependence

$$M_{кр} = M_{кр} - \left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi} t \right) t * h * L_{бараб} * \rho * \left(R - \frac{\left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi} \right) t}{2} \right)$$

$$(22)$$

Let us substitute the numerical data, and take the time data from equation (12). Take the drum diameter 3.2 m, drum length 10 m, blade height 0.5 m, raw cotton bulk thickness 0.2 m, raw cotton density $\rho = 45$ kg/m^3, angular velocity 1 rad/s, friction coefficient 0.3.
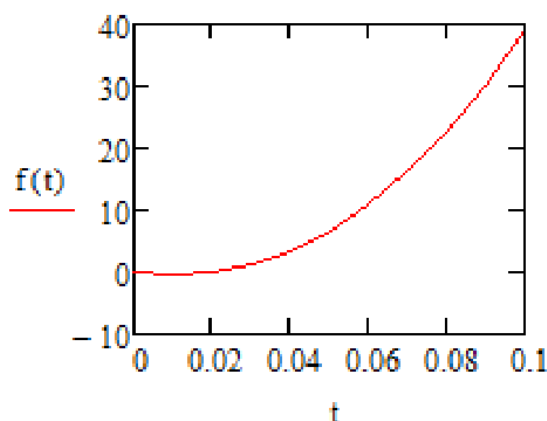

Fig.2. Torque release when raw cotton slides

In Fig.2. the dependence is presented, how the torque changes in time when the raw cotton slides from the slats. Moreover, the torque decreases, this can cause unwanted jerks, which will be transferred to the chain drive and then to the drives of the mechanisms. Given the dynamics of the process, it is possible to plot the change in torque over time and affect the dynamic factor. As mentioned above, to eliminate these jerks, a brake latch is provided in the mechanism. He takes over jerks and extinguishes.

We find the jerk force using the following formula:

$$F_{рыв} = \frac{2M_{осв}}{D} \qquad (23)$$

This force will act on the brake latch. In this case, the brake latch axle diameter can be calculated using the following formula:

$$d = \sqrt{\frac{4\left(L - \dfrac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi}t\right) t * h * L_{бараб} * \rho * \left(R - \dfrac{\left(L - \dfrac{g\cos(\alpha + \omega t - \varphi)}{\omega\cos\varphi}\right)t}{2}\right)}{\pi\left[\tau_{срез}\right]}} \qquad (24)$$

Additionally, this effect affects the oscillations of the system.

$$\omega = \sqrt{\frac{\pi G D^4}{32 J l}} \qquad (25)$$

where: J - moment of inertia of the drum

Conclusion. Based on a theoretical study, it can be concluded that the calculated design scheme of a drum dryer with a chain drive made it possible to derive differential equations for determining the torque, the required power of the electric motor and for choosing the chain brand. From formula (25), we can conclude that the natural frequency of the drum oscillations is half as much for a drum with a drive in the middle than for a drive of a standard design dryer drum.

The derived dependencies show how the torque changes in time when raw cotton slides from the longitudinal shelves. Moreover, the torque decreases, this can cause unwanted jerks that will be transmitted to the chain drive and further to the mechanism drives. Taking into account the dynamics of the process, a graph of the change in torque over time was obtained, which can affect the dynamic factor. To eliminate these jerks, a brake latch is provided in the drive mechanism. He takes over jerks and extinguishes.

References

1. Першин В.Ф. Машины барабанного типа: основы теории, расчета и конструирования. - Воронеж:Изд. ВГУ ,1990. 243 с.

2. Жалкенова С.Т., Ошакбаев П.О. Перемещение материала в барабане. // В сб. научных трудов.-Алматы, АлИИТ, 1994. с. 111-113.

3. Данилов О.Л. Теория и расчет сушильных установок. М.: Изд. МЭИ. 1977.-72 с.

4. Алтухов А.В. Моделирование и расчет барабанных сушильных агрегатов. Наука и образование Южного Казахстана. Серия: Механика и машиностроение., 1, 1995, с. 325-329.

5. С.А.Самандаров и др. Создание очистителей средневолокнистого хлопка-сырца машинного сбора от крупного и мелкого сора. НТО, тема №5. Ташкент -1967.

6. http://xn--l1amhh.xn--p1ai/uchebnik/TOO/620.php Вращающиеся барабанные аппараты, их конструктивные узлы. Расчет элементов конструкции.

7. http://www.detalmach.ru/primer1.htm Выбор электродвигателя и кинематический расчет привода.

INFLUENCE AND CHARACTERISTICS OF DRYING MECHANISMS IN LEATHER PRODUCTION ON THE DERMA LAYER

XOMIDJONOV ABROR

Assistant of Namangan institute of engineering and technology
E-mail.: axomidjonov1990@gmail.com, phone.: (+99894) 300-66-19

Abstract:

Objective. The article is devoted to the description of the drying method of liquid liquid vehicles produced on the basis of a joint solution of heat generated by the authors. The number of leather layers, thermophiles properties and sizes. The content of the dried product is focused on the appearance of dried structures with the emergence of communication. The influence of structures that appear on the surface of thermopam of dry drying is noted. When studying the drying processes of various products, the understanding of the physical essence of the process and the possibility of its mathematical dispersion of products and the quality indicators of the finished product are mainly determined by specific structural and rheological changes. For example, in the process of drying heat-resistant materials, chemical and structural deformation changes determine the quality indicators of a dry product [18].

Keywords: Drying equipment, leather, leather layer, thermos, liquid, sheep skins, enterprise power, chemicals.

Any phenomena that occur during drying (for example, the formation of structure on the surface, chemical reactions, changes in the shape and size of the dried material, the formation of mass flows in the main part of the material, etc.) will lead to the appearance of some "non-classical" points or areas on drying thermogram (for example, turning points or the fate of a monotonic asymptotic increase or decrease in temperature) [2]. As a result, the shape of the drying thermogram changes significantly.

The kinetics of material heating during drying is often more important than the kinetics of moisture loss for determining the properties of the process and describing its mechanism [1, 6]. Therefore, the type of thermogram is often the most informative in terms of understanding the physics of the process.

When liquid-dispersed systems are dried, a certain structure (for example, a film) is formed on the surface, which leads to a change in the thermophysical properties of the surface of the drying material and, as a result, has a limiting effect. evaporation process, which is clearly reflected in the nature of the thermogram.

Sheep and cattle skins were chosen as the studied leather materials for drying on substrates [2, 3]. The main thermophysical properties of the studied materials are identified.

Figure 1 shows the drying of skins under uniform conditions, which allows for the expansion of the drying area of the skins with the help of steam and wind

Methods. For materials with similar basic thermophysical properties, the nature of thermograms is fundamentally different. The process of drying the skin is very similar to the classical drying of a simple capillary-porous body in terms of thermograms. During the drying process, things get more complicated.

There is no clear area of wet skin on the thermogram. The temperature rises continuously during the first drying period. The thermogram has a characteristic inflection point in the wet bulb field [2, 9].
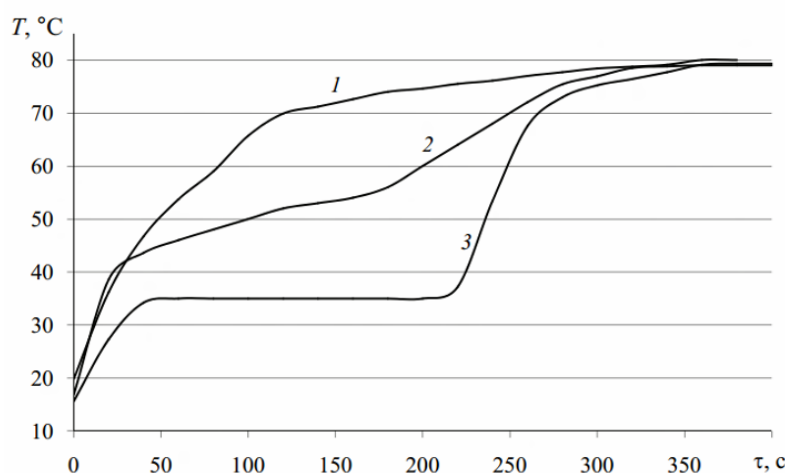
Figure 2. Shows the characteristic thermograms of the desiccant plasticizer (1), distillation stillage (2), and skin moisture (3). Substrate - aluminum, T=80°C, w=3 m/s, layer thickness 0.5 mm

The liquid plasticizer (1) behaves in the distillation of the liquid during the drying process. In this case, the wet bulb area on the thermogram is almost destroyed. At the same time, the thermogram in the wet bulb zone in the first period also has a characteristic fracture [10].

A similar nature of thermograms is associated with the mechanism of formation of certain structures on the surface of the drying product. During the drying process, structures (films, agglomerates, crusts, etc.) are not formed on the entire surface of the body and in the volume of the skin. When the alembic is dried, a thin film immediately begins to form on the surface of the dried product, which eventually turns into a much harder crust.

9

When the plasticizer layer dries, some time after the start of the process, an elastic film forms on the surface, and a liquid pulsation phenomenon is observed under the film. During the drying process, moisture is removed due to the formation of an air gap under the film. The surface film (in the mode of fixing the contact line to the substrate) rises, falls, and deforms in different ways, forming a surface of a complex geometric shape [2, 3, 9].

Results. The nature of the appearance of surface and cast structures is associated with the fractional composition of the dried product and the shape of the particles that make up the dispersed phase. The description of the phenomena of self-organization of such structures is very difficult, therefore, in relation to our problems, it is of practical importance to search for a criterion for assessing the possibility of self-organization of particles of a given product. conditions [11–13].

For a mathematical description of the drying kinetics of such materials, it is proposed to use a joint solution of heat transfer and diffusion problems in a material with a dynamically changing number of layers, thermophysical properties, and layer sizes. In the general case, multilayer systems are used not only to describe heat transfer (diffusion) processes in physical multilayer bodies, but can also be used to describe the process in a physical single-layer body if its properties vary greatly along . or more coordinates.

The drying kinetics of fibrous materials and liquid dispersed systems on substrates is ensured by taking into account the most complete physical approximation of the problem to real conditions, as shown by the experience of studies carried out in the department of processes and apparatuses. Multilayer (usually two-four-layer) investigated body [10]. In this case, layers can also appear and collapse during the calculation.

An algorithm for the formation/degeneration of multilayer problems in the calculation of the drying kinetics of the studied materials is presented [10].

The task of calculating the kinetics of skin drying can be considered as twofold. The first layer is a non-diffusion substrate. The second layer is a liquid layer that changes thickness during the first drying period. In the second period, the thickness of the residual layer does not change. The calculation of the evaporation rate in the first period, the equations for calculating the critical humidity are presented in [1-4].

We divide the drying process into separate stages. At the first stage (at the initial moment of time), before the formation of a film on the liquid surface, a two-layer problem is considered in the calculation. The first layer is a non-diffusion substrate and the second layer is a fluid layer that changes thickness as it dries.

At the second stage, with the formation of a film on the surface of the liquid, one more layer is added to the problem - a film one. The task is threefold. The moment of appearance of this layer can be estimated from the equations obtained in [2]. At the same time, a characteristic inflection point is noted on the thermogram during the first drying period, and the first critical humidity corresponding to this point is distinguished. As mentioned above, when drying, the film layer turns into a hard shell, under which the lower layer remains, similar to the film layer [2, 4,]. The kinetics of the formation of a layer of the earth's crust was studied in [2, 4], and it is possible to calculate the moment of its formation. Thus, another layer is formed - the shell layer, and the problem becomes a four-layer one. During the drying process, the liquid phase evaporates, the liquid layer decreases until it disappears completely. So one layer is broken. The task is threefold. Further processing leads to the degeneration of the film layer into a shell layer. The task is two-layer: one layer is the substrate, and the second layer is the layer of the dried material [8–10].

The process of drying a liquid plasticizer can, with some assumptions, be considered similar to the process of drying an alembic. However, due to the lack of a correct mathematical description of such phenomena as pulsations similar to self-oscillating reactions in the drying layer, the accuracy of describing such a process will be low [12].

Having decided on the algorithm for the formation or degeneration of layers, taking certain correlation dependences for the thermophysical properties of these layers, they jointly solve the problems of heat conduction and diffusion in the classical formulation by the interval method.

The main idea of the interval method is that the process is divided into certain time intervals. The duration of each interval is determined by the nature of the change in the boundary conditions, the characteristics of the drying product, the geometric dimensions of the body, temperature, concentration, or the appearance of certain structures depending on the process time. To solve the problem, the first, previous and next intervals are distinguished. For each interval, according to previously obtained relations, variable coefficients are taken as piecewise constants. Thus, the problem of heat and mass transfer for each interval is linear. For the first interval, the problem is solved taking into account the initial conditions specified at the zero moment of time. Accordingly, at the moment of time in the solution we obtain the temperature distribution given as a function. For the next time interval, the temperature distribution obtained in the previous time interval (ie, actually at the end of the previous interval) is taken as the initial condition at an equal time.

In the formula under consideration, the main feature of applying solutions to problems of diffusion of heat conduction is the mathematical description (or at least a numerical estimate) of the properties of the resulting surface structures. In the first period, it is necessary to evaluate the coefficient of reduction in the intensity of evaporation from the surface and a possible analytical calculation of the thermophysical properties of the structures formed in the drying product.

Conclusion. To date, one of the promising approaches to solving such problems is the use of fractal analysis and the determination of the correlation between fractal parameters and actually observed phenomena [14–15]. The main feature of drying is self-similarity, which allows you to create a curve or surface according to a given algorithm with given parameters. Practice shows that many natural objects created as a result of evolution are also self-similar and therefore resemble fractals. This also applies to dispersed products [16]. Consequently, the use of fractal structures gives a certain possibility of modeling real objects.

At present, the authors are solving the problem of comparing the structures formed on the drying surface of liquid disperse products with certain types of fractal lines or surfaces, as well as linking the properties of real surface structures with fractal parameters.

References

1. Гатапова, Н.Ц. Кинетика и моделирование процессов сухого растворения, покрытия, диспергирования, сольвентных и волокнистых материалов: Единый подход: дис. ... д-р тех. наук : 17.05.08 : защищена 10.06.2005 /Гатапова Наталья Цибиковна. - Тамбов, 2005. - 554 с.

2. Пахомов, А.Н. Кинетика сухого диспергирования на твердых подложках : дис. ... конфеты. тех. наук : 17.05.08 : защищена : 16.03.2001 / Пахомов Андрей Николаевич. - Тамбов, 2000. - 225 с.

11

3. Пахомова Ю.В. Кинетика сухих капель жидкого диспергирования с диффузионно-непроницаемыми подложками: дис. ... конфеты. тех. наук: 17.05.08: защищена 23.12.2011: утв. 23.12.2012 / Пахомова Юлия Владимировна. - Тамбов, 2011. - 283 с.

4. Коновалов, В. Я. О возможностях использования точных, интервальных и приближённых аналитических методов в задачах тепло- и массперекоса в твёрдых телах/В. Я. Коновалов, Е. Н. Туглуков, Н. Ц. Гатапова// Вест. Тамб. Мистер. тех. мука - 1995. - Т. 1, № 1-2. - С. 75-90.

5. Расчет внутреннего тепломассопереноса и кинетики сушки и нагревания волокнистых материалов / В. И. Коновалов [и др.] // Вест. Тамб. государственная технология. Университет - 1997. - Т. 3, № 3. - С. 224 - 236.

6. Пахомов, А.Н. Кинетика высыхания дисперсий на твердых подложках: Дис. … искренний. технологии. наук : 17.05.08: Защищено: 16.03.2001 / Пахомов Андрей Николаевич. - Тамбов, 2000. - 225 с.

7. Пахомова Ю.В. Кинетика высыхания капель жидкой дисперсии на диффузионно-непроницаемых подложках: Дис. ... сахар. технологии. наук: 17.05.08: зарезервировано 23.12.2011: утв. 23.12.2012 / Пахомова Юлия Владимировна. - Тамбов, 2011. - 283 с.

8. Коновалов В.И., Туголуков Е.Н., Гатапова Н.Ц. // Вестн. Тамб. государственная технология. мука 1995г. - Т. 1, № 1-2. - С. 75 - 90.

9. https://scholar.google.ru/citations?view_op=view_citation&hl=ru&user=xa90JrwAAAAJ&citation_for_view=xa90JrwAAAAJ:eQOLeE2rZwMC

10. https://uz.wikipedia.org/wiki/Anor

11. https://saem.kz

12. Kallenberger Waldo E., Hernander Juan F., Preliminary experiments in the tanning action of vegetable tannins combined with metal complexes, - Journai of the American Leather Chemists Association, vol. 78,1983, № 8. - P. 217-222

13. https://studfile.net/preview/7610461/page:3/

14. Черняева Г.Н. и др. Утилизация древесной биомассы / Г.Н. Черняева, С.Я. Долгодворова, Р.А. Степень - Красноярск, 1987. - 166 с.

15. https://scholar.google.ru/citations?view_op=view_citation&hl=ru&user=xa90JrwAAAAJ&citation_for_view=xa90JrwAAAAJ:Y0pCki6q_DkC

16. https://conferencea.org/index.php/conferences/article/view/1208

17. Безопасный дубильный материал для дубления подкладочных кож АО Хомиджонов, ДД Зуфарова, МБ Шамсиева - АКТУАЛЬНЫЕ НАУЧНЫЕ ИССЛЕДОВАНИЯ, 2022

ANALYSIS OF ELASTIC FABRICS FOR COMPRESSION SPORTSWEAR IN THE NEW ASSORTMENT

JOKHONGIR MONNOPOV

Doctoral student of Namangan Institute of Engineering and Technology
E-mail.: mannopovjahongir@gmail.com, phone.: (99893) 914-34-33

JURABEK KAYUMOV

Doctor of Technical Sciences, Namangan Institute of Engineering and Technology
E-mail.: juramirza@gmail.com, phone.: (99899) 051-08-55

NABIJON MAKSUDOV

Associate professor of Namangan Institute of Engineering and Technology
E-mail.: maksudovnabijon@mail.ru, phone.: (+99894) 307-39-47

Abstract:

Objective. The article considers the most important factors in the analysis of the modern range of materials with compressive properties. For the design of compression sports goods, fabric samples were selected and analyzed for hygienic indicators and mechanical properties with the results of experimental tests using standard methods. The characteristics of the analyzed fabrics are expressed in the table, and the YG026T device was used to evaluate the compressive strength of the fabrics. The analysis of the elasticity of the experimental samples was carried out under a force of 6N, and the results of the evaluation of the half-cycle deformations are presented in the elongation diagram.

Methods. A sample of knitted fabrics used for the production of compression sportswear was selected to study the type of knitting, fiber composition, surface density, thickness and structure of knitted fabrics. The YG026T device was used to evaluate the compressive strength of the fabrics, the analysis of the elasticity of the experimental samples was performed under a force of 6N, and the results of the evaluation of the half-cycle deformations are shown in the elongation diagram.

Results. Materials selected to study the type of knitting, fiber composition, surface density, thickness and structure of knitted fabrics. 15 samples were selected to analyze the elasticity of knitted fabrics used for the production of compression sports clothes, and the tensile strength, elongation at break , elongation and elongation under the influence of 6N force, friction resistance and the number of revolutions are expressed in the table.

Conclusions. Using the stock of existing knitting equipment, it is possible to get compression sportswear with good functional parameters from glad woven material with a fiber content of 95% cotton and 5% polyurethane, surface density 181.1. In order to increase consumer demand, it is necessary to conduct a wider survey of users and widely use linear density raw materials.

Keywords: elastic fabrics, compression sportswear, compression strength, compression pressure, deformation.

Introduction. Today, special attention is paid to improving the quality of textiles and ready-made sewing and knitting products through the introduction of new technologies.

A special place in the composition of the assortment of sports goods is occupied by compression items that provide medical requirements for comfort and in the process of operation. The share of the use of such items is constantly increasing.

Active participation in sports is an important part of a healthy lifestyle. Various injuries of the musculoskeletal system (muscles, joints, tendons, muscles) are possible during physical exertion. Therefore, all kinds of protective equipment are widely used to protect the human musculoskeletal system from overloading during sports, excessive tension and sudden movements. According to sports medicine, the main types of sports injuries are bruises, ligament injuries, muscle and tendon strains and sprains, and more severe injuries include dislocations and bone fractures [1].

In order to protect the athlete from the effects of injury factors, as well as to

shorten the rehabilitation period, various human body compression products, including textile materials, are used [2].

All compression garments have the ability to compress the body. The force of compression of different parts of the human body is determined depending on the purpose of use of the items. Today, all of these products are exported by the world's largest manufacturers of compression sports products in a wide range. In the design of body compression products, materials should be selected, ordered and used taking into account the deformation characteristics of the material used.

In international and national level competitions, body compression products are used a lot. However, it is not advisable to use such products for amateur athletes. The price of such products is quite high and it is not always possible to achieve good results. There are also sports goods from some manufacturers at an affordable price level. They can have different designs and common features [3].

Namangan Institute of Engineering and Technology has sufficient laboratory equipment for studying the physical and mechanical properties of highly elastic knitted materials in the educational-scientific laboratory attached to the "Design and technology of light industrial products" and "Knitting technology" departments.

Methods. Nowadays, many materials, knitted and non-woven fabrics are produced from various fibers using modern technologies.

Compression sportswear has high aesthetic and ergonomic requirements. Physiological and hygienic indicators of textile materials will be designed to ensure the comfort and service life of compression sports clothes.

Thus, the analysis of the modern assortment of materials with compression properties shows the need to improve the processes and methods of creating compression products, taking into account the following most important factors:

- properties of new type of elastic fabrics made from local raw materials;
- to improve the quality of compression products by using natural fibers with unique natural properties;
- creation of new types of materials taking into account the requirements and consumption structure of athletes, as well as the conditions and parameters of the use of compression products.

A lot of heat is released from the body during sports. Therefore, it is necessary for sports goods to ensure the release of heat from the body. Woolen and semi-woolen yarns have low thermal conductivity, so they are widely used as materials for various heating items in everyday life and in medicine. The thermal conductivity of cotton thread is slightly better, so it is appropriate to use it in sports clothes. The use of natural thread gives the product good hygienic properties [4].

In addition to the natural thread, the following types of synthetic threads were selected: lycra, latex, polyester, nitron, polypropylene complex thread. Fabric samples were prepared from a combination of these types of raw materials of different linear densities. The selected fabric samples are analyzed for hygienic indicators, mechanical properties with the results of experimental tests according to standard methods. After the experimental test results, the fabric samples were selected for the production of body compression products. Product samples are made of cotton fiber and lycra, latex, polyester, nitron, polypropylene complex thread.

Results. The characteristics of the analyzed fabrics are presented in Table 1. Thus, for the study of the knitting type, fiber content, surface density, thickness and structure of knitted fabrics, a sample of knitted fabrics used for the production of compression sports clothes was selected.
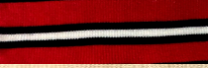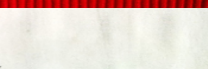
The YG026T device was used to evaluate the compressive strength of fabrics (Fig. 1).

14

Figure 1. YG026T device

Table 1

Classification of elastic knitted fabrics

№	Type of knitting	Appearance of the fabric	Fiber content of fabrics (%)	Linear density, g/m2	Thickness, mm	A group of items
1	Glad		Cotton-95, PU-5	201,5	0,55	**t-shirt and underwear**
2	Glad		Cotton -92, PU-8	203,1	0,7	**t-shirt and underwear**
3	Lastik		Cotton -95, PU-5	232,2	0,8	**t-shirt and underwear**
4	Glad		Cotton -97, PU-3	179,9	0,5	**t-shirt and underwear**
5	Interlock		Cotton -90, PU-10	227,7	0,85	**t-shirt and underwear**
6	Glad		Cotton -95, PU-5	185,3	0,6	**sports underwear**
7	Glad		Viscose -90, PU-10	216,5	0,8	**t-shirt and underwear**
8	Lastik		Cotton -95, PU-5	433,3	1,2	sports suit
9	Glad		Cotton -92, PU-8	192,9	0,7	**sports underwear**
10	Glad		Cotton -95, PU-5	181,1	0,5	**sports underwear**
11	Lastik		Cotton -92, PU-8	251,6	0,6	**t-shirt and underwear**
12	Lastik (China)		PL- 92, PU-8	205,2	0,5	**t-shirt and underwear**
13	Glad (China)		PL-95, PU-5	190,4	0,4	**t-shirt and underwear**
14	Lastik (China)		PL-94, PU-6	351,2	0,8	sports suit
15	Lastik (Turkey)		PL-96, PU-4	450,7	0,9	sports suit

Note: Abbreviations used in the table: PL-polyester fiber, PU-polyurethane fiber.

Discussion. The analysis of the elasticity of the experimental samples was carried out under a force of 6N. Figure 2 shows the stretching diagram of the results of semi-periodic deformation evaluation.

The results of the experiment on the width and length of knitted fabrics under the influence of force (6N) showed that the addition of lycra does not always increase the elastic properties of the fabric. The stretch of fabrics is in the range of 20-60%. These knitted fabrics are elastic (Table 2).

Table 2

Physico-mechanical characteristics of elastic knitted fabrics

Sample number	Breaking strength (sN)		Elongation at break (%)		Elongation of the sample under the influence of 6N force (%)		shrinkage (%)		Friction resistance number of revolutions
	By length	By width	By length	By width	By length	By width	By length	By width	
1	198,3	224,8	62	67	28	31,2	4	3	20000
2	186	193,1	111	123	51	54	3	4	16500
3	190	236	93	109	49	52	3	2	18000
4	181,7	176,6	25	32	10	9	4	4	14500
5	201,3	178,9	36	41	16	14	3	5	18000
6	322,6	345	14	12	23	21	5	3	16500
7	316	367	15	12	54	51	2	3	25000
8	204,3	201,8	54	63	31	36	4	5	18000
9	196,6	213	26	24	11	14	2	3	18000
10	194	237,6	82	97	58	61	3	4	14500
11	130	118,2	226	221	32	60	2	2	17400
12	734	284	284	151	11	47,4	2	3	21000
13	281	330,3	126	244	17	38	2	2	15500
14	404	524	208	347	13	34	3	2	27500
15	393	456	199	306	15	32	2	2	24000
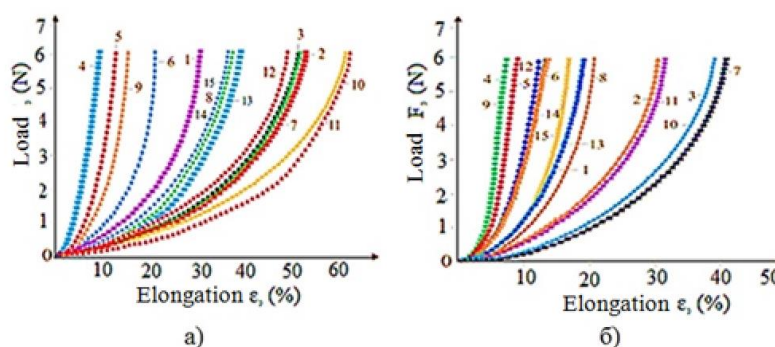
Figure 2. Stretch diagram of various knitted knitted fabrics:
a) by width; b) by length

Conclusion. The results of the work show that, using the stock of available knitting equipment, it is possible to obtain compression sports items with good functional parameters from a material with a fiber content of 95% cotton and 5% polyurethane, a glade texture with a surface density of 181.1. To increase consumer demand, it is necessary to conduct a wider survey of users and widely use linear density raw materials. The current technology is universal, firstly, it allows you to produce a number of compression items, and secondly, this range is in great demand, and newly acquired items without seams on the paintwork can compete with imported analogues.

References

1. Sports median // Textbook for institutes of physical culture - M Physical culture and sport. 1987- 326 s

2. Polievsky S.A. Hygiene is more sportswear and equipment / S.A. Polievsky -M: Physical culture and sports 1987 - 284 p.

3. Filatov. V N Elastic textile shells / V N. Filatov - M .: Legprombytizdat 1987 -248 p.

4. N.B. Maksudov. Creation of technology for the development of compression sports goods with improved hygienic and deformation properties. Dissertation. Tashkent 2020.

5. Saidova Sh.A. Development of a method for designing ergonomic clothing using three-dimensional scanning: Ph.D. dis. cand. those. Sciences: 27.10.2017 / Sh.A. Saidova - Moscow 2017.-19 p.

6. Taya, Y. Evaluation method of clothing fitness with body – part 4: Evaluation by waveform spacing between body and clothing /Y. Taya, A. Shibuya, T. Nakajima // Journal Textile Machinery Society of Japan, 1995, 48(11): pp. 261-269.

7. Liu, Y.J. Survey on CAD Methods in 3D Garment Design /Y.J.Liu, et al.// Computers in Industry, 2010, 61, pp. 576-593

8. Fan, J. Clothing appearance and fit, Science and Technology/J. Fan, W. Yu, L. Hunter //Woodhead Publishing Limited and The Textile Institute, 2004

9. Zhang, X. Numerical simulation of 3D dynamic garment pressure /X. Zhang, K.W.Yeung, Y. Li // Textile Research Journal, 2002, 72 (3): pp. 245-252.

10. Apeagyei, P. Usability of Pattern Customising Technology in the Achievement and Testing of Fit for Mass Customization /P. Apeagyei, R.Otieno// Journal of Fashion Marketing and Management, 2007, 11(3),: pp. 349-365.

11. Petrosova, I.A. Development of design methodology external form of clothing based on three-dimensional scanning. Thesis. specialty 05.19.04 Technology of garments.

12. Broun, P.J. Consumer choices clothing ideas for people with special need / P.J. Broun // Iowa State University Extension, 2003, 196 p

13. Connel, L.J. Body scan analysis for fit models based on body shape and posture analysis /L.J.Connel, P. Ulrich, A. Knox, et al. // National Textile Center Research Briefs-Management Systems Competency, 2004, 84 p

14. Liu, R., Lao, T. T., Xiao Wang, S. (2013). Technical knitting and ergonomical design of 3D seamless compression hosiery and pressure performances in vivo and in vitro. Fibers and Polymers, 14(8), 1391-1399.

15. Bhatia, D., Malhotra, U. (2016). Thermophysiological wear comfort of clothing: an overview. Journal of Textile Science and Engineering, 6(2), 250.

16. Junyan, H.U. (2006). Characterization of sensory comfort of apparel product.

Hong Kong Polytechnic University

17. Chunyan, Q., Yue, H. U. (2015). Design of outdoor sports monitoring function cycling Jerseys. European Journal of Business and Social Sciences, 4(2), 180-189.

18. De Raeve, A., Vasile, S. (2016). Adapted performance sportswear. In: Proceedings of the 7th International Conference on 3D Body Scanning Technol. Lugano, Switzerland, 30 Nov.-1 Dec. 2016, pp. 9-15.

19. Hassan, M., Qashqary, K., Hassan, H. A., Shady, E., Alansary, M. (2012). Influence of sportswear fabricproperties on the health and performance of athletes. Fibres and Textiles in Eastern Europe, 4(93), 82-88.

20. Hu, J. (2016). Active coatings for smart textiles. Elsevier Ltd (Cambridge).

21. Gupta, D. (2011). Design and engineering of functional clothing. Indian Journal of Fibre and Textile Research, 36(4), 327-335.

22. Goonetilleke, R., Karwowski, W. (2016). Advances in physical ergonomics and human factors. In: International Conference on Physical Ergonomics and Human Factors, Florida, USA, July 27-31, 2016, p. 489.

INVESTIGATION OF THE INFLUENCE OF SPEED MODES OF THE COMBINED DRUM ON THE QUALITY INDICATORS OF THE TAPE

MATISMAILOV SAYPILLA

Associate Professor of Tashkent Institute of Textile and Light Industry
E-mail.: msayfula779@gmail.com

MATMURATOVA KUMRIXON

Doctoral student of Tashkent Institute of Textile and Light Industry
E-mail.: qumrixonmatmuratova@gmail.com, phone.: (+99897)500-25-48

KORABAYEV SHERZOD

PhD of Namangan Institute of Engineering and Technology
E-mail.: sherzod.korabayev@gmail.com

YULDASHEV ALISHER

PhD of Tashkent Institute of Textile and Light Industry
E-mail.: alisher_yuldashev_2018@mail.ru

Abstract:

Objective. In this research work, using the system of modern technological equipment, the effect of the parameters of the main working organs of the combed machine on the quality indicators and fiber length of the wick obtained from the selection of medium fiber cotton was studied. It was determined that the staple length of the fiber increased by 2.07 mm at a speed of 350 min^{-1}. The purpose of the study is to study the influence of the comb speed of the combed drum on the quality parameters of the sliver and the staple length of the fiber.

Results. In the experiment, the influence of the speed of rotation of the comb drum on the quality parameters of the combed sliver was studied. As a result, when the rotation speed of the combed drum is 350 min^{-1}, the coefficient of variation of the combed sliver is improved, the staple length of the fiber is increased by 2.07 mm.

Conclusion. The distribution of the mass of fibers over the cross section of the tape tape corresponds to the normal distribution law Cm/Um=1.25 (2.72/2.32). Unevenness of the combed sliver in 1 m segments decreases with a decrease in the speed of the combed drum, and with an increase in its speed it increases by 12%. The clogging of the batt decreases with an increase in the speed of the drum, in which the number of defects per 1g of tape is 26 i.e. the minimum value of the compared options.

Introduction. Every year, the range of manufactured textile products is replenished with new names of goods that are in great demand both on the domestic and foreign markets. Thanks to the introduction of high-performance modern technologies into the industry, the export of products of the industry's enterprises has grown 110 times compared to the first years of independence. Today, light industry products are exported to more than 60 countries of the world, and the sales geography is constantly expanding [1-4].

Combed cotton yarn traditionally has a stable and high demand not only at domestic textile enterprises, but also abroad, where it is used to produce a high-quality range of products. The equipment installed in recent years at the cotton-spinning factories of the Republic of Uzbekistan in the process of complex modernization and re-equipment of the textile industry enterprises allows, according to its technical characteristics, to obtain high-quality combed yarn from medium-staple cotton [5-8].

At the same time, combed yarn from medium-staple cotton is increasingly being used in the production of textile products, successfully replacing yarn from long-staple cotton [9-14].

Thus, the replacement of long-staple cotton varieties with medium-staple selection varieties in the production of yarn for fabrics and knitwear is a very urgent task facing textile enterprises around the world, including for the Republic of Uzbekistan.

In connection with the above, it is of interest to study issues related to improving the preparation of the combed sliver on combing machines, as well as the influence of the speed modes of the combed drum on the quality indicators of the combed sliver using medium fiber cotton.

The purpose of this work is to study the influence of the frequency of rotation of the combed drum on the quality indicators of the combed sliver. To study the influence of the speed modes of the combed drum on the quality indicators of the tape, an experimental study was carried out on a Comber E66 comber by RIETER, installed in the production conditions of JV LLC TEXTILE FINANCE KHOREZM.

The filling parameters of the machine under study, speed modes and technological wiring of the working bodies corresponded to the operating instructions for the machine. For the production of semi-finished products and yarn, factory sorting was used, consisting of cotton fiber of type 4, class I, class "Yakhshi", breeding variety Bukhara 102. Experimental studies were carried out in three versions with a speed of the third receiving drum of 300, 350, 400 min-1. Processing of raw materials was carried out according to the technological chain of modern equipment from RIETER (Switzerland).

Methods and results. To assess the quality of semi-finished products and yarn, modern laboratory equipment from Uster was used. The results obtained from testing semi-finished products and yarns were evaluated by comparison with HTD norms and norms according to Uster-Statistics [15-17].

The quality indicators of semi-finished products are shown in Table 1. Before the research, the quality of the carding, ribbon tape and feeding laps from the tape connecting machine was checked.

From Table 1. it can be seen that the quality of the semi-finished products developed for the experiments is high, which is associated with the use

Table 1.

Quality indicators of initial semi-finished products

№	The name of indicators	Card tape	Tape with "0" head	Canvas
1	Linear density, tex	5900	5000	73750
2	The coefficient of variation, %			
	- by 1 m segments	1,3	0,84	0,56
	- by 3 m segments	0,8	0,59	-
3	Roughness in section %			
	-linear, Um	2,72	2,32	1,54
	-coefficient of variation Cv	3,41	2,90	
	Level of Ust	39	12	
4	The number of defects in 1 g of carding			
	sliver pcs:	68		
	nodules	57		
	Skin with fiber	9		
	rubbish	2		

Modern equipment. The quality of the card sliver meets the 39% level according to Uster-Statistics, the sliver with the "O" head - 12% the level of Uster. The distribution of the mass of fibers over the cross section of the tape tape corresponds to the normal distribution law Cm/Um=1.25 (2.72/2.32)

Square uneven laps on 1 meter segments 0.56% compared options.

A combed sliver was produced from the resulting laps on a Comber E66 comber from Rieter (Switzerland).

The combed sliver of each option was tested on the Uster-Tester 5-S400. The clogging and length of the fiber in the tape were determined on the Uster-Afis-Pro device [18-21].

The results of measurements of the main parameters are shown in Table 2. Table 2 shows that the unevenness of the combed sliver in 1 m segments decreases with a decrease in the speed of the combed drum, and with an increase in its speed it increases by 12%.

Table 2.

Main indicators of the quality of the combed sliver

	The name of indicators	Comb drum rotation frequency, min⁻¹		
		300	350	400
1	Tape linear density, ktex	5,02	5,01	5,0
2	Coefficient of variation by segments Main indicators of the quality of the combed sliver	1,95	1,73	2,1
	2m	1,50	1,33	1,61
	3m	1,32	1,15	1,40
3	Ribbon irregularity			
	-linear, Um	3,60	3,34	3,48
	-coefficient of variation, Cv	4,5	4,18	4,36
4	Staple mass length of fibers, mm	34,26	36,33	35,40
	modal mass length, mm	31,03	33,06	32,15
5	Short fiber content, %	4,8	3,9	4,6
6	The number of defects per 1 g of the tape, pcs	29	26	30
	knots	28	25	29
	waste	0	3	1

A decrease in the length of the fiber by 1 mm [4-6] with a large staple mass length causes a decrease in the specific breaking load of the yarn when tested with a skein by 3–5%, and with a smaller staple mass length of the fiber, by 6–10%.

20
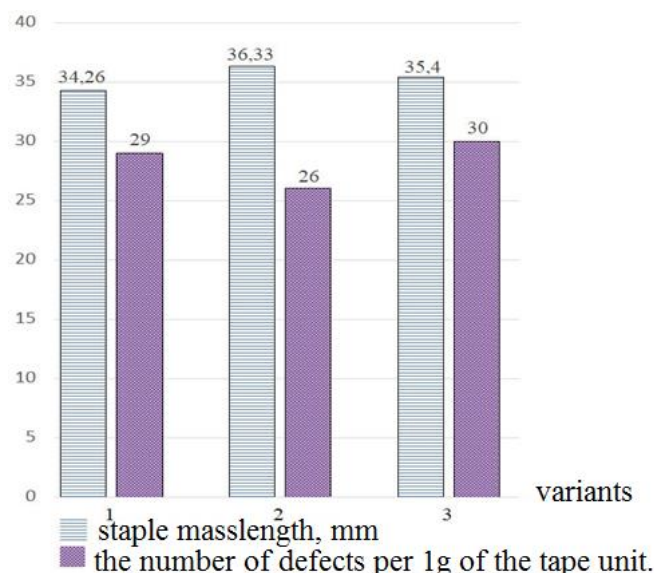
igure 1. Staple length of fibers and the quality of defects per 1 g of tape by options

From Table 1. and Fig. 1. It can be seen that in variant 2, the maximum staple mass is the length of the fibers at the speed of the combed drum ngr-350 min-1 (Lsht 36.33 mm). The minimum value of the staple weight of length in 1 option (Lpcs 34, 26 mm). Comparing the values of the staple length in options 1 and 2, we see that the speed of the drum has a decisive influence on this indicator.

The clogging of the batt decreases with an increase in the speed of the drum, which can be seen in option 2 in Fig. 1. in which the number of defects per 1g of tape is 26 i.e. the minimum value of the compared options.

The above studies allow us to conclude that an increase in the speed of the combed drum leads to an increase in the staple length of the fiber and an increase in the specific breaking load of the yarn.

Conclusion. 1. The distribution of the mass of fibers over the cross section of the tape tape corresponds to the normal distribution law Cm/Um=1.25 (2.72/2.32);

2. Unevenness of the combed sliver in 1 m segments decreases with a decrease in the speed of the combed drum, and with an increase in its speed it increases by 12%.

3. The clogging of the batt decreases with an increase in the speed of the drum, in which the number of defects per 1g of tape is 26 i.e. the minimum value of the compared options.

References

1. V.D. Frolov, G.V. Bashkova et al. Technology and equipment for textile production. 4.1 Production of yarn and threads: a tutorial. Ivanova: IGTA, 2006-436p.

2. Matismailov S.L., Pirmatov A.P., Salamov A.A. Comparative analysis of the influence of combing machine filling parameters on the quality of the combed sliver. XIX International scientific and practical conference "Advances in Science and Technology", Moscow, 2019

3. Matismailov S.L., Makhkamova Sh.F., Razhapov O.O. Optimization of filling parameters of combing machines. "Fan, talim, ishlab chikarish integrationlashuvi sharaitida buttermilk tozalash, tuqimachilik, engil sanoat, matbaa ishlab chikarish innovation technologylari dolzarb muammolari va ularning echimi" Republics of Ilmiy-Amaliy Conference. Tashkent 2021. TTESI. April 28 Pages 350-353

4. Pavlov Yu.V. Investigation of the influence of individual factors on fiber damage during carding on a ChMD-4 machine. R.s. Textile industry. 1978, no. 10, p. 9-12.

5. Yuldashev A.T., G`afurov K., Matismailov S.L., Matmuratova Q.R. The property of twisted yarn obtained from single yarn of various spinning methods, IJARSET. India. Vol. 7, Issue 2, Fevral, 2020. 12947-12950.

6. Matismailov S.L., Korabayev Sh.A., Aripova Sh.R., Matmuratova K.R. Investigation of Influence ofa New Twist Intensifier on the Properties of the Twisted Yarn. Turkish Journal of Computer and Mathematics Education Vol.12 No. 5 (2021), 1943-1949.

7. Jumaniyazov K.J., Yuldashev J., Bobojanov X. Raschet sily treniya volokon o prednyuyu gran zuba diskretizirushchego barabana pryadilnoy mashiny. Scientific journal Universum: Texnicheskie nauki 2018.

8. Pirmatov A., Matismailov S.L., Gofurov K.G., Jumaniyazov Q., Makhkamova Sh.F. "Spinning technology". Textbook., T., " Adabiyot uchkunlari " Publishing House TTYeSI. 2018.

9. Pirmatov A., Gofurov K.G., Matismailov S.L., Fayzullaev Sh.R., Makhkamova «Technology and equipment of textile products». - T .: Izdanie "Adabiyot uchkunlari" TITLP, 2018.

10. Karabayev Sh.A. Distribution of twist down the yarn and its impact on the production of competitive products. Diss. PhD. Namangan 2020.

11. Opatrný, T., Richterek, L., & Opatrný, M. (2018). Analogies of the classical Euler top with a rotor to spin squeezing and quantum phase transitions in a generalized Lipkin-Meshkov-Glick model. Scientific Reports, 8(1). https://doi.org/10.1038/s41598-018-20486-

12. Korabayev Sh.A; Matismailov S.L; Yuldashev A.T., Atanbayev D.D. (2020) "Study Of Fiber Movement Outside The Crater Of Pnevmomechanical Spinning Machine", Solid State Technology. Vol. 63 : Iss. 6. Pages 3460-3466. http://www.solidstatetechnology.us/index.php/JSST/article/view/3473

13. Sh.A.Korabayev, U.X.Meliboyev, U.A.Boboyev, D.O.Raximberdiyev. (2020) Investigation of optimization of the speed of the working parts of a rotor spinning machine. International Journal of Future Generation Communication and Networking Vol. 13, No. 4, (2020), pp. 964 – 975. http://sersc.org/journals/index.php/IJFGCN/article/view/32528

14. Matismailov S.L., Gofurov K.G., Korabaev Sh.A. Investigation of the influence of twist intensifiers (torque stop) (TS) on the quality of rotor yarn // FarPI - 2019.Vol. 23.No.1. -Page. 142-145.

15. Korabayev Sh.A., prof. HELL. Djuraev A.D., Assoc. Matismailov S.L. "Effective design of the tube for pulling yarn in a spinning device." Tashkent Institute of textile and light industry Republican Conference, Tashkent, 2018 May., II-section, pp. 4-5.

16. Putra, V. and Rosyid, M. (2015) Theoretical Modeling for Predicting the Optimum Twist Angle of Cotton Fiber Movement on OE Yarn Made by Rotor Spinning Machine. Journal of Applied Mathematics and Physics, 3, 623-630. doi: 10.4236/jamp.2015.35074.

17. Islam, Z. (2019). Comparing Quality Parameters of Yarn Produced by Ring, Rotor, and Compact Spinning System. European Scientific Journal, ESJ, 15(3), 461. https://doi.org/10.19044/esj.2019.v15n3p461

18. Putra, V. and Rosyid, M. (2015) Theoretical Modeling for Predicting the Optimum Twist Angle of Cotton Fiber Movement on OE Yarn Made by Rotor Spinning Machine. Journal of Applied Mathematics and Physics, 3, 623-630. doi: 10.4236/jamp.2015.35074.

19. M. Taher Halimi; M. Ben Hassen; B. Azzouz; F. Sakli, Effect of cotton waste and spinning parameters on rotor yarn quality, Journal of the Textile Institute, 2007, Vol. 98 No. 5, pp. 437–442.

20. Koc, E.; Carl, A. L.; and Cherian, I.: Wrapper fibers in Open- end rotor spun yarns: Yarn Properties and Wrapper Fibers, Fibers& Textiles in Eastern Europe, V. 13, No. 2(50), p. 8-15, April/ June 2005.

21. Sh.A.Korabayev, D.A.Djurayev, S.L.Matismailov, Perfection of Designs and Theoretical Bases of Calculating Roller Tubes for Yarning // International Journal of AdvancedResearch in Science, Engineering and Technology. INDIA. Vol. 5, Issue 12, December 2018 – P. 7583-7588. http://www.ijarset.com/upload/2018/december/21-IJARSET-Nurbek-5.pdf

DETERMINATION OF THE GEOMETRIC AND KINEMATIC PARAMETERS OF THE DEVELOPED CHAIN GEAR FOR THE 2SB-10 DRYER

SHODMONKULOV ALISHER

Assistant of Jizzakh Polytechnic institute
E-mail.: alishershodmonqulov1982@gmail.com, phone.: (+99899) 775-06-41

JUMANIYAZOV KADAM

Professor of "Cotton Industry Scientific Center" JSC OA
Phone.: (+99890) 993-72-60

JAMOLOV RUSTAM

Professor of "Cotton Industry Scientific Center" JSC OA
E-mail.: rustam-djamolov1972@mail.ru, phone.: (+99897) 737-02-49

YULDASHEV XURSHID

PhD of Jizzakh Polytechnic institute
E-mail.: yoldoshevxurshid1989@gmail.com, phone.: (+99891) 188-22-29

Abstract:

Objective. The article presents the calculated data for determining the geometric and kinematic parameters of the developed chain transmission for the 2SB-10 cotton dryer.

Methods. According to the developed drive scheme, the beater was assembled with a leading drive of the drum, consisting mainly of an electric motor with a power of 7.5 kW, a rotation speed of 1430 rpm, a gearbox with a gear ratio of 1 to 31.5.

Results. Therefore, the value of the chain pitch is limited by the maximum allowable value of the angular velocity of the small sprocket.

Conclusion. The given calculation data are necessary for the manufacture and assembly of the developed chain transmission for the drum dryer 2 SB-10.

Keywords: chain drive, diameter, drive, sprocket, center distance, pitch, number of teeth.

Introduction. Taking into account the analysis of previous work in the laboratory of drying, cleaning of raw cotton, "Cotton Industry Scientific Center" JSC developed a drive scheme for a 2SB-10 cotton dryer, the scheme of which is shown in Fig. 1 [1].

The advantage of the developed drive is that the generated variable loads from the side of the dryer drum are ground using the chain drive (that is, with the chain length adjustment and the choice of center distance) [2].

Methods. According to the developed drive scheme, the beater was assembled with a leading drive of the drum, consisting mainly of an electric motor with a power of 7.5 kW, a rotation speed of 1430 rpm, a gearbox with a gear ratio of 1 to 31.5.

Taking into account the recommended speed of rotation of the drum dryer, which is equal to 10 rpm, the diameters of the pulleys and sprockets installed on the drive drive were selected.
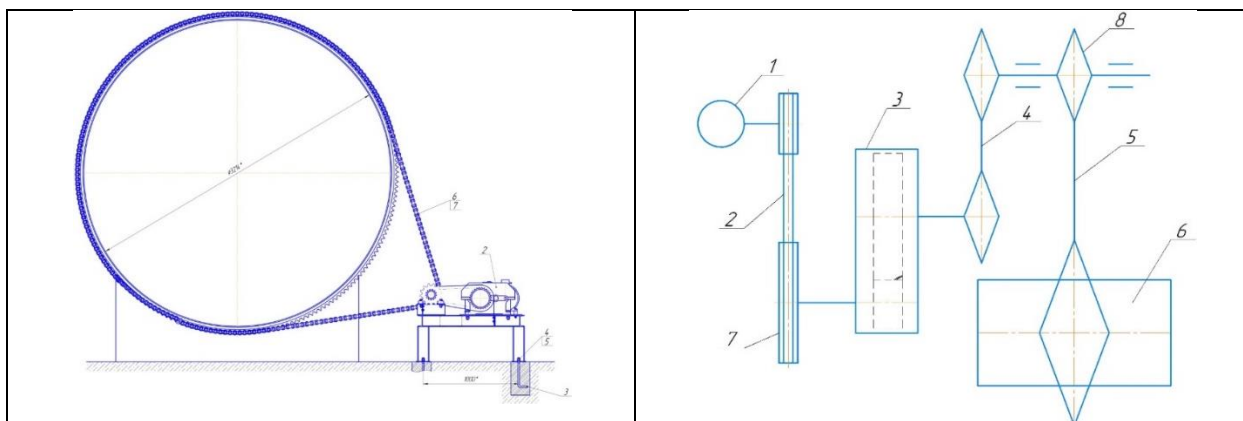
1-electric motor, 2-belt transmission, 3-reducer, 4, 5-chain transmission, 6-dryer drum 2SB-10, 7-pulley, 8-sprocket

Fig.1. Diagram of a dryer drum with an improved drive (left) and a separate diagram of the leading drive (right)

The smoothness, durability and noiselessness of the developed chain transmission largely depend on the value of the chain pitch; the smaller the step, the less dynamic loads and the higher the quality of the transmission. At the same time, the static strength and load capacity of the chains increase with increasing pitch, as the dimensions of the parts that make up the chain hinges increase.

Results. Therefore, the value of the chain pitch is limited by the maximum allowable value of the angular velocity of the small sprocket. Based on these considerations, to calculate other design parameters of the chain transmission, the chain pitch is chosen equal to (Fig. 2): $t = 50.8$ mm, from table 1.
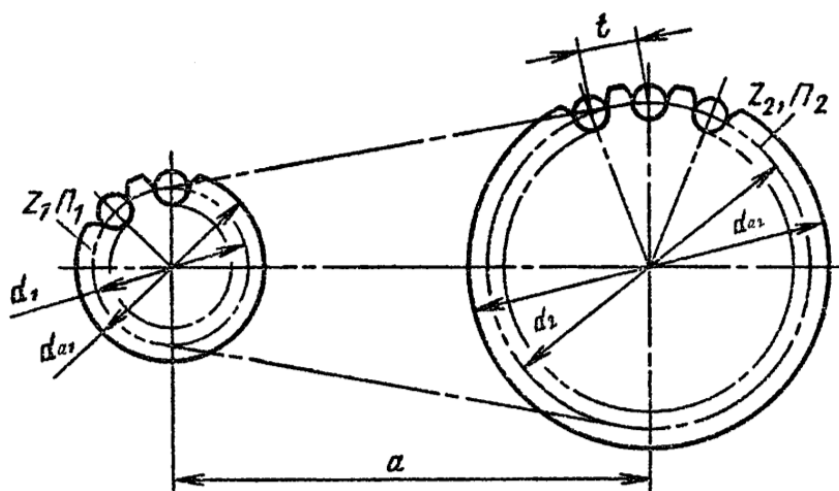
Figure. 2. Scheme for determining the geometric dimensions of the chain transmission

With the selected pitch of the flail and the known diameter of the drum dryer equal to 3200 mm, taking into account the height of the tooth, the number of teeth of the large crown will be determined as follows:

First, we determine the perimeter of the ring gear, taking into account the height of the tooth, for example, 25 mm

$$L_3 = 2.\pi. r = 2*3,14*1,6 = 10048 \text{ mm};$$

From here, the number of teeth of the large crown will be: 10048/50,8 = 197,79 pcs. Round up to a whole number, and take 198 pcs.

The main technical characteristics of drive chains are given in Table 1 [3].

The minimum number of teeth of the smaller sprocket for roller chains is selected according to the empirical dependence:

$$Z_{1min} = 29 - 2 u$$

With $u \leq 2$ m/s, this number can be increased to $Z_{min} \geq 13…15$, with

$u \geq 2$ m/s $Z_{min} \geq 19$, and in drives with shock loads, $Z_{min} \geq 23$ should be taken.

Table 1

Main technical characteristics of drive chains

Parameter		Roller and sleeve single-row normal according to GOST 13568-75 (sprockets according to GOST 591-69)							Toothed according to GOST 13552-81 (sprockets according to GOST 13576-68)				
Pitch, mm			12,7	15,87	19,05	25,4	31,75	50,8	12,7	15,875	19,05	25,4	31,75
Breaking load F, kN		4,5	17,8	22,1	31,0	55,1	86,2	223,1	23,6-52,7	38,7-88,7	71,6-140,8	115,7-215,6	170,6-302,7
Inner Link Width or chain width B,mm		3,0	5,4	6,48	12,70	15,68	19,05	31,75	22,5-52,5	30-70	45-93	57-105	69-117
Roller diameter d, mm		2,31	4,45	5,08	5,96	7,95	9,55	14,29	3,45	3,9	4,9	5,9	7,9
Weight of 1 m chain q, kg		0,20	0,65	0.80	19		3,8	9,70	1,3-3,0	2,2-5,0	3,9-8,0	6,5-12,0	10-16,7
Permissible safety factor [s] at rotational speed, rpm	Before 50	-	7	7	7	7	7	7	20	20	20	20	20
	400	-	8,5	8,5	9,3	9,3	10,2	11,7	24	24	26	26	32
	800	-	10,2	10,2	11,7	11,7	14,8	16,3	29	29	33	33	41
	1000	-	11,0	11,0	12,9	12,9	16,3	-	31	31	36	36	46
	1200	-	11,7	11,7	14	14	19,5	-	33	33	40	40	51
	1600	-	13,2	13,2	-	-	-	-	37	37	46	46	-
	2800	18,0	18,0	-	-	-	-	-	51	51	-	-	-
Permissible pressure* in chain joints [p], MPa, at rotational speed, rpm	Before 50	-	34,3	34,3	34,3	34,3	34,3	34,3	19,6	19,6	19,6	19,6	19,6
	400	-	28,1	28,1	25,7	25,7	23,7	20,6	16,1	16,1	14,7	14,7	13,7
	800	-	23,7	23,7	20,6	20,6	28,1	14,7	13,7	13,7	11,8	11,8	10,3
	1000	-	22,0	22,0	18,6	18,6	16,3	-	12,9	12,9	10,8	10,8	9,32
	1200	-	20,6	20,6	17,2	17,2	14,7	-	11,8	11,8	9,81	9,81	8,43
	1600	-	18,1	18,1	14,7	14,7	-	-	10,3	10,3	8,43	8,43	-
	2800	-	13,4	13,4	-	-	-	-	7,6	7,6	-	-	-
The highest allowable rotational speeds - small sprocket, rpm with the number of teeth z	15	-	2300	1900	1350	1150	1000	600	-	-	-	-	-
	23	-	2500	2100	1500	1250	1100	650	-	-	-	-	-
	30	-	2600	2200	1550	1300	1100	700	-	-	-	-	-
	17-35	-	-	-	-	-	-	-	3300	2650	2200	1650	1300
Permissible number of strokes [U] per 1s		-	60	50	35	30	25	15	80	65	50	30	25

Recommended, maximum speed v, m/s		For roller chains up to 15	for bushings up to 1	25
Recommended number of teeth for smaller sprocket z at gear ratio	1-2	30-27		40-35
	2-3	27-25		35-31
	3-4	25-23		31-27
	4-5	23-21		27-21
	5-6	21-16		23-19
	>6	17- 15		19-27

Note: *For bush-roller chain = 15÷30; with gear =17÷ 35.

Based on the above, for our case, the number of teeth of the smaller sprocket can be chosen to be 18 pcs.

From here, the diameter of the smaller sprocket will be equal to:

$$d_{a1} = 914,4/3,14 = 291,2 \text{ мм.}$$

Then the gear ratio "u" can be determined by the following dependence [4]:

$$u = \frac{n_1}{n_2} = \frac{Z_2}{Z_1} = \frac{198}{18} = 11$$

From this formula, it is possible to determine the rotation speed of the driving sprocket, based on the fact that the required rotation speed of the driven sprocket (drum dryer) will be selected within 10 rpm.

$$n_1 = 11 \times 10 = 110 \text{ об/мин}$$

Center distance.

Discussions. The approximate optimal center distance of the chain drive is selected depending on the chain pitch t, usually within:

a≥ (30÷50) t (smaller values for small gear ratios) (1)

The minimum center distance **"atip"** of the chain transmission is taken depending on the gear ratio " *u* " of the transmission and the condition that the angle of wrapping of the chain of the smaller sprocket is at least 120 °, i.e. with u > 3

$$a_{min} = \frac{9 + u}{20} \cdot (d_{a1} + d_{a2}), \qquad (2.2)$$

$$a_{min} = \frac{9 + 11}{20} \cdot (3,2 + 0,29) = 3,49 \text{ м}$$

where: da1, da2 are the diameters of the tops of the teeth of the driving and driven sprocket.

The maximum allowable center distance can be selected:

$$a_{max} = 80t = 80 \times 0,058 = 4,64 \text{ m.}$$

We determine the speed v, m/s, of the movement of the chain:

$$v = n \cdot z \cdot t / (60 \times 10^3),$$

where n is the speed of the sprocket, min-1;

z-is the number of teeth of the same sprocket;

t-is the pitch of the chain.

Then:

$$v = 110 \times 18 \times 58,8 / (60 \times 10^3) = 1,94 \text{ м/с.}$$

Conclusion. The given calculation data are necessary for the manufacture and assembly of the developed chain transmission for the drum dryer 2 SB-10.

26

References

1. Р.Джамалов и др. «Разработка ресурсосберегающей технологии сушки и его внедрение в производства». НТО. АО «Paxtasanoat ilmiy markazi», Ташкент, 2020. 34 с.

2. http://www.pke.kz/ru/articles/684-barabannaja_sushilka___princip_raboty_sushilnyje_barabany_almaty/

3. file:///C:/Users/Nazirov/Desktop/%D0%A0%D0%B0%D1%81%D1%87%D0%B5%D1%82%20%D1%86%D0%B5%D0%BF%D0%B8.html

4. https://studfile.net/preview/3740401/

UDC 677.21.021

DETERMINATION OF DRYER DRUM MOISTURE EXTRACTION DEPENDING ON ITS OPERATING MODES

JAMOLOV RUSTAM

Professor of "Cotton Industry Scientific Center" JSC OA
E-mail.: rustam-djamolov1972@mail.ru, phone.: (+99897) 737-02-49

SHODMONKULOV ALISHER

Assistant of Jizzakh Polytechnic institute
E-mail.: alishershodmonqulov1982@gmail.com, phone.: (+99899) 775-06-41

YULDASHEV XURSHID

PhD of Jizzakh Polytechnic institute
E-mail.: yoldoshevxurshid1989@gmail.com, Phone.: (+99891)188-22-29

Abstract:

Objective. The article presents the results of experimental studies of a drying drum with a developed chain drive installed in a cotton gin plant to determine the moisture intake from raw cotton, depending on its operating modes.

Methods. As can be seen from table 3.5. the average values of moisture extraction from raw cotton inside the drum depend on the feed rate of raw cotton to the dryer drum and its mode of operation.

Results. This is explained by the fact that with an increase in the speed of rotation of the drying drum, the time spent by the dried cotton inside the drum decreases.

Conclusion. Thus, it can be said that the actual values of moisture extraction from the dried raw cotton located inside the drum in drum dryers depend on its productivity for dried cotton and on the operating mode, that is, on the rotation speed of the drum dryer.

Keywords: Flail, drying, drum, SB, drive, cotton, moisture extraction.

Introduction. A chain drive for a 2SB-10 drum dryer has been developed, manufactured and implemented [1].

The following revolutions of the drum dryer were investigated: 8, 10 and 12 rpm. To obtain reliable data in the compared variants of experiments, raw cotton of the second industrial grade with the same preliminary moisture content equal to 13.6%. At each repetition of the experiments, the moisture content of raw cotton after the drum dryer was determined at least three times and the actual average moisture withdrawal was determined for the compared variants of the experiments. The temperature of the drying agent for all compared variants of experiments was unchanged and set equal to 1800C. The amount of the supplied drying agent for all variants of the experiments was equal to 180,000 m3/hour. The results of the experiments are shown in table 1.

Methods. As can be seen from table 3.5. the average values of moisture

extraction from raw cotton inside the drum depend on the feed rate of raw cotton to the dryer drum and its mode of operation. At the selected performance values of the drying drum for dried cotton 8, 9 and 10 t/h, for example, when the drum is operated at a speed of 8 rpm, the actual value of

moisture extraction from raw cotton inside the drum decreases from 5.7% to 4.4 %, respectively, when the drum is operating at a speed of 10 rpm, the actual average value of moisture extraction from raw cotton located inside the drum decreases from 5.3% to 4.0%.

Table 1.

Determination of the actual moisture extraction of the dryer drum, depending on the productivity of the dried cotton and its mode of operation

Investigated operating modes of the drum dryer, rpm	Actual moisture withdrawal as a percentage of dried cotton, depending on the performance of the dryer drum for dried cotton, t/h		
	8	9	10
	5,6	4,8	4,3
8	5,8	4,7	4,4
	5,7	4,8	4,5
Medium	**5,7**	**4,76**	**4,4**
	5,1	4,4	4,1
10	5,4	4,4	4,0
	5,4	4,5	3,9
Medium	**5,3**	**4,43**	**4,0**
	4,6	3,7	3,4
12	4,7	3,8	3,3
	4,7	3,8	3,4
Medium	**4,66**	**3,76**	**3,36**

Results. This is explained by the fact that with an increase in the speed of rotation of the drying drum, the time spent by the dried cotton inside the drum decreases. Also, with a constant supply of the amount of drying agent with its unchanged temperature, with an increase in the productivity of the drum for dried cotton, it leads to a decrease in moisture extraction from raw cotton.

Discussions. Also, as can be seen from the data in Table 3.5. with the selected identical productivity for dried cotton, the average indicators for moisture extraction from raw cotton decreases with an increase in the drum rotation frequency, that is, from the speed of rotation of the dryer drum. If, at a selected productivity of 8 t/h, with an increase in the speed of rotation of the dryer drum from 8 rpm to 12 rpm, the

average indicators for moisture extraction from raw cotton decreases from 5.6% to 4.66%, for example, with a productivity of 10 t/min. hour with an increase in the rotation speed of the dryer drum from 8 rpm to 12 rpm, the average indicators for moisture extraction from raw cotton decreases from 4.4% to 3.36%. This is explained by the fact that with an increase in the speed of rotation of the drying drum, the time spent by the dried cotton inside the drum decreases.

Conclusion. Thus, it can be said that the actual values of moisture extraction from the dried raw cotton located inside the drum in drum dryers depend on its productivity for dried cotton and on the operating mode, that is, on the rotation speed of the drum dryer.

References

1. R.K. Jamolov , A.M. Shodmonkulov. Improvement of the drive of the dryer 2sb-10 in order to reduce its energy consumption. American Journal of Interdisciplinary

Research and Development ISSN Online: 2771-8948 Website: www.ajird.journalspark.org Volume 03, April, 2022.

2. Першин В.Ф. Машины барабанного типа: основы теории, расчета и конструирования.-Воронеж:Изд. ВГУ ,1990. 243 с.

3. Zhalkenova S.T., Oshakbaev P.O. Movement of material in the drum. // On Sat. scientific works. - Almaty, AIIIT, 1994. p. 111-113.

4. Danilov O.L. Theory and calculation of drying installations. M.: Ed. MPEI. 1977.-72 p.

5. Altukhov A.B. Modeling and calculation of drum drying units. Science and education of South Kazakhstan. Series: Mechanics and engineering., 1, 1995, p. 325-329.

6. S.A. Samandarov et al. Creation of cleaners for medium-staple raw cotton harvested from large and small litter. NTO, topic number 5. Tashkent -1967.

7. http://xn--l1amhh.xn--p1ai/uchebnik/TOO/620.php Rotating drum machines, their structural components. Calculation of structural elements.

8. http://www.detalmach.ru/primer1.htm Electric motor selection and drive kinematic calculation.

UDC.677.021

THEORETICAL STUDIES ON SCREW CONVEYOR FOR TRANSPORTATION AND CLEANING OF LINTER AND DESIGN OF CONSTRUCTIVE PARAMETERS OF TRANSMISSIONS

DJURAEV ANVAR

Professor of Tashkent Institute of Textile and Light Industry
E-mail.: adjurayev1948@gmail.com

YULDASHEV KOZIMJON

PhD, Andijan Machine-building Institute
E-mail.: kozimjon590@gmail.com, Phone.: (+99897) 994-94-83

TESHABOYEV OYBEK

Doctoral student of Andijan Machine-building Institute
E-mail.: masterlevelteshaboyev@mail.ru, phone.: (+99899) 903-19-96

Abstract:

Objective. The article presents theoretical studies on the basis of structural parameters of screw conveyors and transmissions that transport and clean fluff. An analysis of the laws of change of the angular speed of the conveyor screw shaft was obtained. Connection graphs are built based on processing laws of screw motion. Based on the analysis of the connection graphs of the parameters, the limit values of the height of the screw waves, which ensure sufficient cleaning efficiency and high productivity, have been determined. Determination of the parameters of the fluff-carrying and cleaning screw conveyor based on theoretical studies.

Methods. In system dynamic analysis studies, all rotating masses of the equipment are attached to the screw shaft. In the studies, the mechanical dynamic characteristics of the electric motor were mainly taken into account. The kinetic energy of the system was determined using Lagrange's II-order equation, and a system of differential equations representing the motion of the machine unit for the screw conveyor was derived.

Results. Based on the solution of the problem, the law of movement of the screw of the screw cleaner was obtained. The pitch of the screw, the height and pitch of the wave on the surface of the screw, and the

angle of elevation were taken into account. Based on the analysis of the received laws, it was determined that the amplitude of the angular speed fluctuation in the movement of the screw shaft depends mainly on the height of the wavy surface on the screw surface, without changing the resistance and friction from the foam.

Conclusion. Dynamic and mathematical models representing the dynamics of a single-mass machine assembly of a screw conveyor were developed taking into account the mechanical dynamic characteristics of the electric drive, inertial parameters, and technological and frictional resistances. the laws of change of angular speed of the screw shaft were obtained, graphs of dependence were constructed and recommended parameters were developed.

Keywords: Screw conveyor, pressing machine, transportation, construction, fluff, waste, screw shaft, noise, chain transmission

Introduction. Calculation scheme and mathematical model of the screw conveyor machine unit

After saw jin machine, the linter is separated from the seed with the help of linters machines. Screw conveyors are used to transfer the waste in the obtained linter to the pressing machine [1]. Available screw linter carrier will transport shaft linter (with blade) along gutter. In the screw cleaner that we offer, the screw blade is made wavy, which increases the fluffiness of the linter being transported, as a result, the waste in the linter is separated and then it goes out of the shell slots in the grid fast.

In addition, the movement of the wiper blade is transmitted to the screw shaft from an electric walker through a reducer and a coupling. In this case, in theoretical studies, the system can be considered as a single-mass machine unit. However, in order to reduce noise, adequately adjust the cleaning mode and ensure efficiency, we proposed to transfer the movement to the screw shaft through a chain drive. Here, belt elements were used in the construction of the chain transmission used [2]. A dynamic model for a single-mass machine unit is presented in Figure 1.

$$M_g \qquad \boxed{B} \qquad M_{ec} = M_{e_1} + M_{e_0}\sin\omega t \pm \delta M_{e_1}$$

$$J_{ke}, \dot{\varphi}_e$$
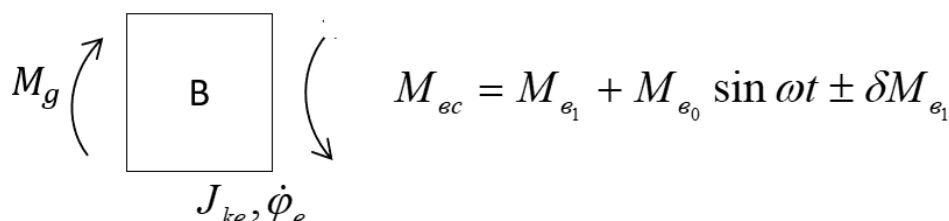
Figure 1. Screw machine for linter transportation and cleaning, dynamic model for a single mass machine unit

In system dynamic analysis studies, all rotating masses of the equipment are brought to the screw shaft. In the studies, the mechanical dynamic characteristics of the electric motor were mainly taken into account. A.E. Levin proposed this dynamic mechanical characteristic [3]:

$$\dot{M}_g = \Psi(\omega_c - p\dot{\varphi}_e) - \frac{1}{T_э}M_{ю};$$

$$T_э\dot{\Psi} = 2M_k - \Psi - \Psi_э\omega_c + p\dot{\varphi}_e - M_{ю};$$

$$T_э = \frac{1}{\omega_c S_k}; \; \Psi = \frac{S_k}{S}(M_{ю} + T_э\dot{M}_{ю})$$

(1)

here, $\dot{\varphi}_e$ – referred mass – screw shaft angular velocity; $M_{ю}, M_k$ – torque on the drive shaft and its critical value; p – number of pairs of poles; ω_c – frequency of rotations

of the power supply; $T_Э$ – electromagnetic constant time of the conductor; Ψ – additional variable.

Using Lagrange's II equation [4], we determine the kinetic energy of the system:

$$T = \frac{1}{2} J_{kв} \dot{\varphi}_в^2; \qquad (2)$$

here, $J_{kв}$ – moment of inertia used to the screw shaft.

Because the strap elements are not taken into account in the system, potential energy in the Lagrange equation and Rayleigh's dissipative functions are also not taken into account. External effective forces:

$$M_T = M_ю - M_{вc} - M_и \qquad (3)$$

here, $M_{вc}$ – resistance moment coming from the linter carried in the screw shaft.

Based on the obtained kinetic energy and taking into account (3), the system of differential equations representing the motion of the machine unit for the screw conveyor is as follows:

$$\dot{M}_g = \Psi(\omega_c - p\dot{\varphi}_в) - \frac{1}{T_Э} M_ю;$$

$$T_Э \dot{\Psi} = 2M_k - \Psi - \Psi_Э \omega_c + p\dot{\varphi}_в - M_ю; \qquad (4)$$

$$T_Э = \frac{1}{\omega_c S_k}; \ \Psi = \frac{S_k}{S}(M_ю + T_Э \dot{M}_ю)$$

$$J_{kв} \dot{\varphi}_в = M_ю - M_{в_1} + M_{в_0} \sin \omega t \pm \delta M_{в_1} - M_и$$

here, $M_{в_1}, M_{в_0}, \delta M_{в_1}$ – the constituents of the technological resistance coming from linter, respectively the average value, amplitude and random constituent, $M_и$ – moment of resistance of frictional forces on screw shaft supports.

Solution for the problem and analysis of results.

It should be noted that if the electric motor is Y132S-8, P=2.2 kW, n=710 rev/min, the rotation frequency of the propeller shaft is $n_{ум}$ =25,4 да $n_в$ =27,9 rev/min.

The problem is solved numerically $J_{kв} = 7,14\,кг \cdot м^2;$ $M_{в_1} = (45 \div 65)Нм;$ $M_{в_0} = (5,0 \div 10)Нм;$ $\delta M_{в_1} = (0,05 \div 0,07)Нм;$ and $M_и = (35 \div 45)Нм$.

Initial conditions for solving (4): $t = 0; \ \dot{\varphi}_в = 0; \ M_ю = 0; \ M_{вc} = 0.$

Based on the solution of the problem, the law of movement of the screw of the screw cleaner was obtained. The pitch of the screw, the height and pitch of the wave on the surface of the screw, and the angle of elevation were taken into account. The obtained motion laws are shown in Figure 2.

The analysis of the discovered laws revealed that, provided the resistance and friction from the linter do not change, the height of the wave-like surface on the screw surface largely determines the magnitude of the angular velocity fluctuation in the movement of the screw shaft. Additionally, the value of the wave step on this surface determines how frequently the angular velocity oscillates (Fig. 2).

$t_в=0,21$ м; $t_т=0,042$ м;
$h_т=0,006$ м; α=0,12 рад

а

$t_в=0,21$ м; $t_т=0,025$ м;
$h_т=0,006$ м; α=0,1 рад

б

$t_в=0,21$ м; $t_т=0,018$ м;
$h_т=0,006$ м; α=0,08 рад

в

$t_в=0,21$ м; $t_т=0,014$ м;
$h_т=0,006$ м; α=0,055 рад

г
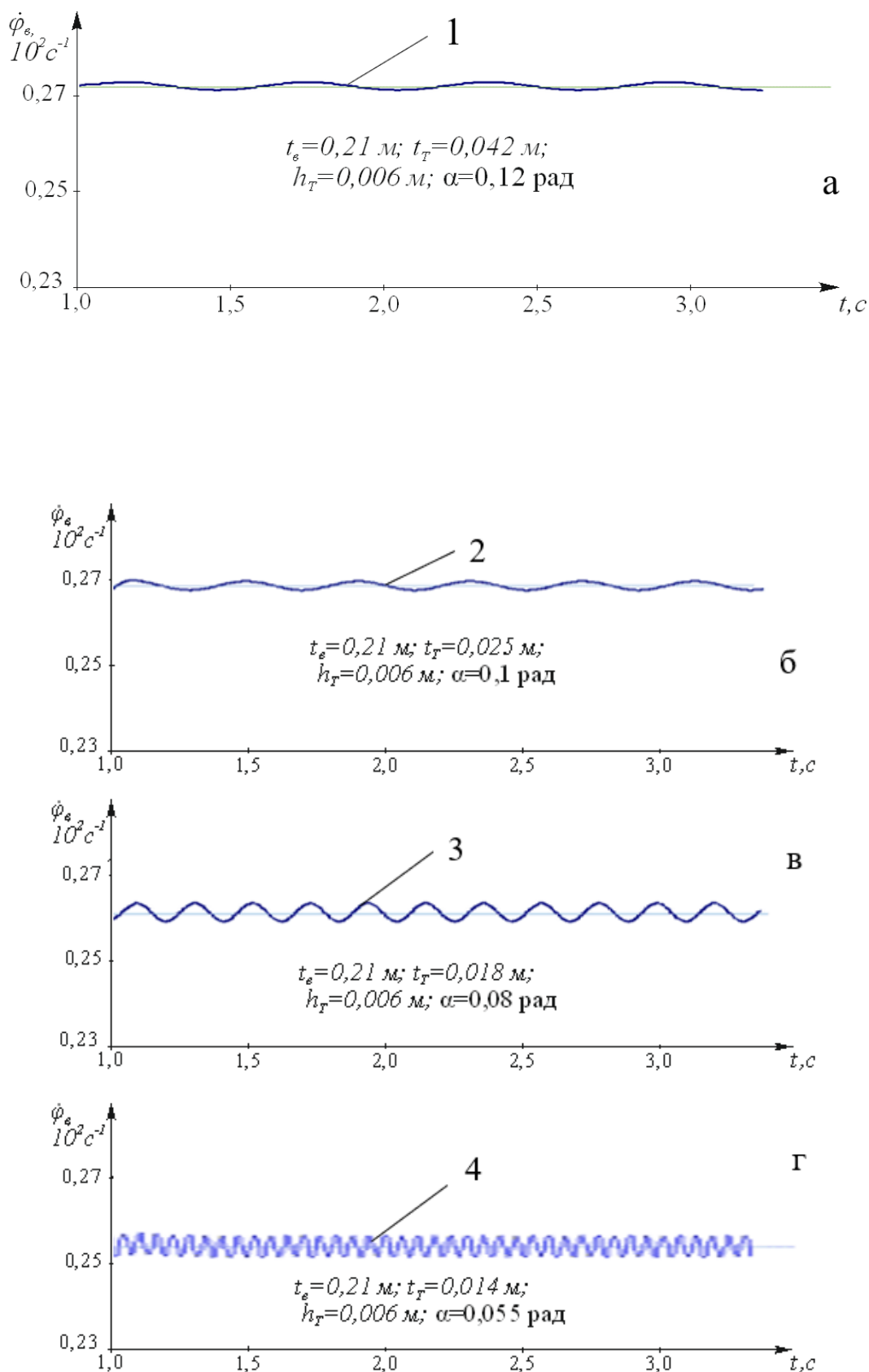
Figure 2. The laws of changing the angular speed of the propeller shaft

The construction of connection graphs was based on analyzing the screw motion rules. The graphs illustrating the relationship between the screw's changing

angular speed and the height of the waves on its surface are shown in Fig. 3.

Based on the graph analysis, when the wave height increases from $0,6 \cdot 10^{-2}$ m to $11,5 \cdot 10^{-2}$ m and is equal to $M_{вс}/M_{вс}^x = 0,7$, it was found that the range of angular velocity changes increases from $1,62$ c^{-1} to $2,52$ c^{-1} in a non-linear pattern.

It was found that when the loading was increased to $M_{вс}/M_{вс}^x = 1,9$, the values of $\Delta\dot{\varphi}_в$ increased from $2,21$ c^{-1} to $4,47$ c^{-1}.

Considering that the wave screw shaft is known to be in the range of $\Delta\dot{\varphi}_в \leq (2,5 \div 3,5)c^{-1}$ according to the results of experimental studies, if it is desirable to choose a load in the range of $M_{вс}/M_{вс}^x = (1,2 \div 1,4)$, it is recommended that the height of the waves on the screw is within $(0,8 \cdot 1.25) \cdot 10^{-2}$ m.

Fig. 4 shows graphs of dependence of the angular velocity of the screw shaft of the lint remover on the increase of the loading from the linter.

Based on the analysis of the obtained graphs, if the relative values of loading are increased from 0.4 to 2.2, the unevenness coefficient of the angular speed is hт=0.006 m; it can increase from 0.01 to 0.07 in case of α=0.12 rad. If hт=0.015 m; α=0.055 rad, it was found that the values of d increase from 0.024 to 0.131. In order to ensure the desired cleaning effect, according to the results of experimental studies, the values of δ are recommended to be within the range of (0.04÷0.05).

In order to ensure the desired cleaning effect, according to the results of experimental studies, the values of δ should be within the limit of (0.04÷0.05) $M_{вс}/M_{вс}^x \leq (0,8 \div 1,25)$ values are recommended.

$$1 - M_{вс}/M_{вс}^x = 0,7; \qquad 2 - M_{вс}/M_{вс}^x = 1,0; \qquad 3 - M_{вс}/M_{вс}^x = 1,3;$$
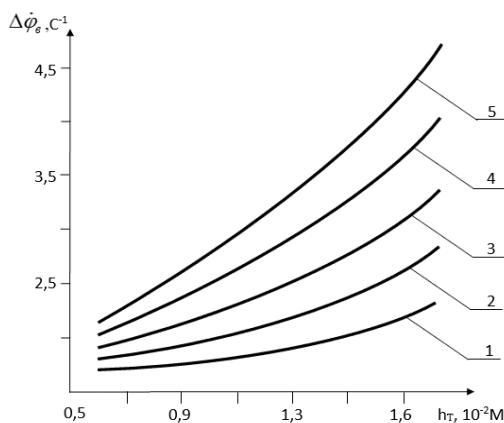
$$4 - M_{вс}/M_{вс}^x = 1,6; \qquad 5 - M_{вс}/M_{вс}^x = 1,9.$$

Fig 3. Graphs of the dependence of the change in the coverage of the screw angular speed on the increase of the height of the waves on the surface of the screw
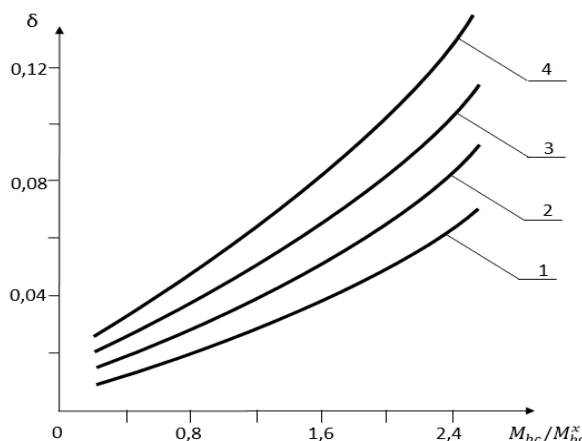
here, $1 - h_T = 0,006\ m;\ \alpha = 0,12\ rad;$
$2 - h_T = 0,009\ m;\ \alpha = 0,1\ rad;\ \ 3 - h_T = 0,0012\ m;\ \alpha = 0,08\ rad;$
$4 - h_T = 0,015\ m;\ \alpha = 0,055\ rad;$

Fig 4. Graphs of the load dependence of the change of the roughness coefficient of the angular speed of the wiper screw shaft

Conclusion. The mechanical dynamic properties of the electric motor, inertial parameters, technical and frictional resistances were taken into account when developing dynamic and mathematical models that reflect the dynamics of a single-mass machine assembly of a screw conveyor. Based on the numerical solution of the problem, the laws of change of the angular speed of the screw shaft of the external conveyor of fluff cleaning were obtained. Graphs of the dependence of the screw angular velocity coverage on the height of the waves on the screw surface were constructed.

Considering that it is in the range of $\Delta\dot{\varphi}_\theta \leq (2,5 \div 3,5)c^{-1}$ according to the results of experimental studies, it is advisable to choose the load in the range of $M_{\theta c}/M_{\theta c}^x = (1,2 \div 1,4)$, it was recommended that the height of the waves in the screw should be within the limit of $(0,8 \cdot 1.25) \cdot 10^{-2}$m.

References

1. Akhmedkhodzhaev Kh. T., Aliev M.A. On the damage of seeds during pneumatic transportation of raw cotton. "Cotton Industry" 1977 No. 2 P.7-8

2. Djuraev, A. Mamakhanov, K. Yuldashev. "Improvement of constructions of chain transmissions of technological machines and justification of parameters". Monograph. "*Science and Technology*" Tashkent. 2019

3. Juraev A. Rotary mechanisms of technological machines with variable gear ratios. – Tashkent: Labor. 1990. -223 p.

4. Feridman M.V., Moments of inertia of bodies, - M .: Mashinostroenie, 1977. - 511 p.

5. .Spivakovsky A.O. and Dyachkov V.K. Transport vehicles. Ed. 2nd revision And extra. M., Mechanical engineering, 1968, p. 356.

6. Shukurov M.M. etc. Patent Res. Uzbek Screw conveyor. UZ IAP 032701 Bull. No. 2, 2007.

7. Abdugafarov X.J. etc. Patent Res. Uzbek Screw conveyor. FAP No. 01141 Bull. №10, 2016

8. A. Dzhuraev et al. Screw conveyor. Patent UZ IAP 06472, Bull. №5, 2021

9. A. Djuraev, K. Yuldashev. Scientific basis of improvement of screw conveyor design of technological machines. Monograph, Uzb "Usman Nasir media", Namangan, 2022, 140 p.

10. Djuraev A. 1987 Dynamics of working mechanisms of cotton-processing machines (Tashkent: Fan) 168 p.

11. Yunusov S Z, Khaidarov A and Bobomurodov T G 2013 Machine unit with the mechanism of a composite cylinder of technological machines Theory of machines and working process MNPK 2013 pp 26-7

12. Mansurova M A, Madrakhimov Sh and Umarova Z M 2016 Analysis of the influence of the lengths of the coupler and rocker arm links on the position of the flat four-link mechanism Theory of mechanism and machines 14 1(2)pp 21-9

13. Dzhuraev A, Zukhriddinov A, Mukhammedjonova S, Mavlonova I and Tursunova G 2020 Dynamics of machine aggregates with mechanisms of working bodies for cleaning cotton from fine impurities. Solid State technology. Blind Peer Review Referred Journal 63(6) pp 169-81

14. Anvar Dzuraev, Sardor Sayitkulov, Bekzod Bozorov. Investigation of working bodies of cotton cleaning machine // Modern Innovation, System and Technologies, 2021, 1(4).

15. A.Djuraev, K.Yuldashev, O.Teshaboyev. Results of experimental determination of torque moments and noise on fluff transporter and cleaner screw conveyor shafts. Technical science and innovation journal №3/2022. p 188

16. A.Djuraev, K.Yuldashev, O.Teshaboyev. Determination of radial speed in screw conveyor shafts based on experimental research. Scientific Journal Research and education Volume 1, Issue 8. 2022. p 192

17. A.Djurayev, K.Yuldashev, O.Teshaboyev. Construction scheme and mathematical model of screw movement with a curvilinear working surface of a conveyor for fibrous materials. Innovative solutions to technical, engineering and technological problems of production International scientific and technical conference 2022.

18. K. Yuldashev. Improvement of the construction of the screw conveyor for the lint carrier and cleaning and justification of its parameters. Doctor of Philosophy (PhD) dissertation in technical sciences, Namangan 2020. 120 pages.

19. N.Joraev. Development and parameterization of resource-efficient screw conveyor construction for woven materials with two belts and wavy surface. Doctor of Philosophy (PhD) dissertation in technical sciences, Namangan 2022. 121 pages.

20. Djuraev, A. Mamakhanov, K. Yuldashev. "Improvement of constructions of chain transmissions of technological machines and justification of parameters". Monograph. "Science and Technology" Tashkent. 2019

CREATION OF TECHNOLOGY AND EQUIPMENT FOR IMPROVED CLEANING OF COTTON FROM SMALL IMPURITIES

KHASHIMOV SABITKHAN

Associate Professor of Namangan Civil Engineering Institute
E-mail.: xashimovsabitxan@gmail.com

ISAKHANOV KHAMIDJON

Associate Professor of Namangan Institute of Engineering and Technology

MURADOV RUSTAM

Professor of Namangan Institute of Engineering and Technology
E-mail.: rmuradov1956@mail.ru

Abstract:

Objective. Cotton gins are used for ginning in regional cotton gins and clean districts of Uzbekistan using ginning devices of UK or 1XK type and pile-drums of their original design. Damage to the natural properties of cotton in the cleaning wound (the seed is destroyed and the length of the fiber is reduced) in the general protocol, it is possible to ensure a loss of 750-800 million soums per year to the cotton ginning plant. To eliminate this damage, we presented a new improved device (pic. 2).

Methods. In order to develop the optimal version of the improved cotton cleaning device, the factors that affect it during the cleaning process: a (angle formed by the mesh surface with the horizontal plane), μ (friction coefficient of the mesh surface), ω (vibration frequency of the mesh surface), A (vibration amplitude of the mesh surface) based on such parameters, a mathematical model was created (expression 1-2). Based on these expressions, a program was created using MatLAB files.

Results. A theoretical experiment was conducted using the Runga-Kutta method. Based on the obtained results, it was graphically observed that the movement of the piece of cotton on the surface of the mesh surface is uniform in cases where the friction coefficient of the mesh surface is μ=1, the angle of inclination is 26-29 degrees, the number of vibrations is ω=8 Hz, and the amplitude of vibrations is A=20 mm.

Conclusion. On the basis of the parameters obtained above, it will be possible to make an acceptable version of the experimental copy of the device for cleaning cotton from small impurities (2 - picture). Information about the difference and effectiveness of this device from previous devices is presented in the article.

Keywords: raw cotton, mathematical model, separator, vibrating sieve, impurity, seeds, defect, cotton gin.

Introduction. Cotton is the economic backbone of our country. The fact that Uzbekistan ranks sixth in the world in cotton cultivation, private initiatives in the industry create ample opportunities to deepen international standards and reforms, bring cotton industry products to international markets, further develop international cooperation in the industry, as well as widely attract investments from large international branded enterprises in the textile industry.

It is known that in connection with the announcement by the international committee of the Cotton Campaign of the end of the boycott of Uzbek cotton in recent years, interest in our cotton and the products of our textile industry has been growing in other consumer countries. The global cotton market is expected to reach US$46.5 billion by 2027, with a CAGR of 2.74% between 2020 and 2027.

According to experts, an increase in the consumption of cotton fiber in Uzbekistan is expected in the near future. Today, our country has developed a program for the development of textile and light industry in Uzbekistan. It is planned to increase up to 80% of the total production for the processing of cotton fiber and increase the export potential of

Uzbekistan's industry by more than 3 times.

As mentioned above, the production of raw cotton is at a high level, but its processing does not meet the international level. According to international experts: "The attractiveness and competitiveness of the Uzbek cotton fiber is low", the reason for this is insufficient cleaning of the cotton fiber, the presence of non-fibrous impurities and because of them the quality of the fiber does not meet the required level.

Methods. As a result of the analysis, it turned out that cotton gins of the regions and their regions of Uzbekistan, including the cotton gin of the Torakorgan district of Namangan region, mainly use cotton gins of the UHK or 1KhK type. used (Fig. 1). Even large state-owned cotton processing enterprises (American companies Platt-Lummus, Hardwick-Etter, Murray and Continental-Moss-Gordin) use drum-type drum cleaners of the original design in the cotton cleaning process.[1].

In the course of further observations, it turned out that, on the one hand, although cleaning devices based on a drum with pins have a good cleaning effect, on the other hand, due to the mechanical effect of the drum pins on cotton fiber and seeds, it was found that this significantly affects its natural properties, that is, the cleaned cotton ball is broken into smaller pieces (1 cotton ball contains 7-12 seeds), i.e. 1 lump is divided into 7-12 parts. In addition, the damage rate of cleaned cottonseed is 0.4 percent. This in turn causes about 0.2% fiber defects. These 0.2% defects in some cases lead to a drop in fiber quality from high to good or from good to medium, which leads to a decrease in the price of sold fiber by 30-40 thousand soums per ton. This can provide significant (750-800 million soums) economic losses for an enterprise producing 20-25 thousand tons of cotton fiber per year [2].
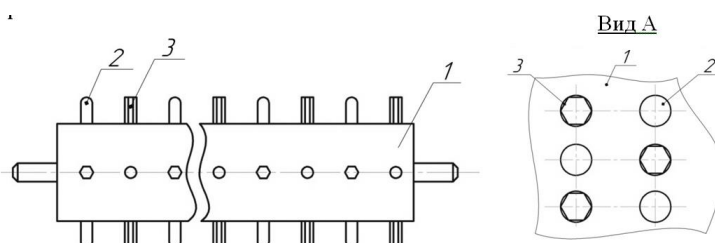
Fig. 1. Peg drum used in a cotton gin. Here: 1- drum; 2- faceless hammers; 3-6-sided hammers. It leads to an increase in the cleaning efficiency of devices based on peg drums - up to 20%

According to the data obtained by experts as a result of analytical experiments at the cotton ginning plant of the Mingbulok district of the region, the proportion of defects and impurities in the composition of cotton fiber (Namangan-77, 1 - grade and good) is: impurities - 0.5%, fibers with seed husks - 0 .8%, broken seeds - 0.5%, with immature seed fiber - 0.5%, a fragment of immature fiber - 0.1%, tangled fibers - 0.1%, only 2.5%. In addition, the percentage of rejects and impurities (type 1) as a percentage

class: high - 2.0%; good-2.5%; average-3.0%; simple-4.0; impurities amounted to 5.5%. From the above data, it can be seen that the percentage of defects and impurities in the fiber increased with the change in classes.

On the basis of the above data, it can be said that peg drum cleaners not only cause damage to seeds and economic damage, but also negatively affect the further stage of development of seeds extracted from seeds under the influence of mechanical shocks. The percentage of

seed defects damaged by such blows was 1.2% (with the amount of contamination before cleaning 2.5%). Damaged seeds and raw cotton, in turn, affect the yield of cotton on the farm (the yield is less by 3-5 t/ha) and its varieties, which leads to the cultivation of poor-quality cotton raw materials in the future, and ultimately to a decrease in income.

Our goal is to eliminate the above disadvantages, purify cotton from small impurities based on new innovative

Recent developments in this area require the use of digital technologies in all aspects. It is known that when solving industry problems, optimal solutions can only be obtained by an exact mathematical expression of the process and the creation of software tools based on this model. Mathematical modeling is a method of formalization and description of quantitative and qualitative aspects of objects, processes, events using

technology and ultimately obtain cotton fiber that meets the requirements without compromising the natural properties of cotton, reduce the amount of non-powder fibers into fibers, damage to the seed husk during cleaning. It is planned to prevent importation, provide a quality seed product in accordance with the demand for seeds obtained from cotton raw materials in the future, and carry out other positive activities.

mathematical models. The technological process (Fμ) of cleaning cotton from small impurities on the surface of a mesh surface (vibrating sieve) or a separator, as an existing object of study, is generally expressed by the following functional relationships (1). Let us express the technological process (Fμ), which took place on the mesh surface as an existing object of study, through the following functional relationships.

$$F\mu = f(\Omega_T, \Omega_I, \Omega_X) = f[(\Omega_{T1}, \Omega_{T2}, \Omega_{T3}, \ldots, \Omega_{Tn}), (\Omega_{I1}, \Omega_{I2}, \Omega_{I3}, \ldots, \Omega_{In}),$$
$$(\Omega_{X1}, \Omega_{X2}, \Omega_{X3}, \ldots, \Omega_{Xn})] \qquad (1)$$

Here: Ω_T - external factors (technological indicators that need to be found for a cotton gin in the horizontal and vertical directions, including the amplitude and frequency of the vibrational movement of the mesh surface, the angle of inclination, vibration and other influences that provide surface surface pulsation); Ω_I - internal factors (this factor includes parameters that indicate the internal factors of the object's properties, i.e. the physical

and mechanical properties of the cotton jet, the size of the cotton jet, the parameters of the mesh surface, etc.), Ω_X - Unaccounted for factors are taken into account (combination of lumps associated with the flow of raw cotton, forming a flow of cotton as a result of the pulsating and vibrational movement of the mesh surface, and other factors). Then we can express the movement of the cotton ball on the mesh surface as the following function:

$$F\mu = \Omega_T(\alpha, \mu, \omega, A), \qquad (2)$$

that is, in this case, the movement is only a (the angle formed by the mesh surface with the horizontal plane), μ (mesh surface friction coefficient), ω (mesh surface vibration frequency) depending on the parameter A (mesh surface vibration amplitude).

Results. We create algorithms and software based on the mathematical model developed above and conduct experiments using the MatLab software package using the Runge-Kutta method. Based on the

obtained results, the coefficient of friction of the mesh surface is μ=1, and the angle of inclination α=26-29 degrees, the number of vibrations ω=8 Hz mesh surface. By providing such an action, the cleaning of cotton from small impurities can be effective. Therefore, such a solution is the basis for the manufacture of an acceptable version of the experimental specimen of the device we need, which cleans cotton from small impurities.

The improved device, based on a new efficient technology for extracting small impurities from the contents of cotton, provides for the maximum use of the mesh surface to get rid of small impurities in the separation process, for this, a lump of cotton moving from the mesh surface to the next mesh surface 2 first falls on the protective surface (4). As a result of the feedback, the cotton gradually changes its direction.

Similarly, when a wad of cotton hits a vertical protective surface, such as a wall, the cotton will rotate as it moves and, as a result of the impact, will begin to move from the wall to the surface of the 2-mesh surface. In the next flow, the cotton ball passes through 3-4-5-6 mesh surfaces of the device, collects the cleaned cotton into the falling chamber (7) and is transferred to the required places. During the separation process, the impurities contained in the raw cotton are removed from the apparatus through a special chamber (5) (Fig. 2).
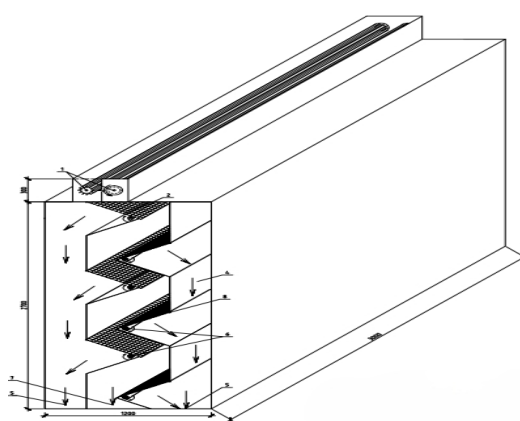
1. Movement provider
2. Mesh surface (vibrating screens)
3. Protective-guiding surface
4. Protective surface
5. Impurity chamber
6. Cams (ellipsoids)
7. Moving grid surface
8. Chamber for cleaned raw cotton

Fig. 2. Spatial view of the improved cotton gin

To improve the quality of cleaning, the device provides the ability to adjust the distance between the feeder shafts (80-100 mm) and replace the mesh surfaces that perform the separation function.
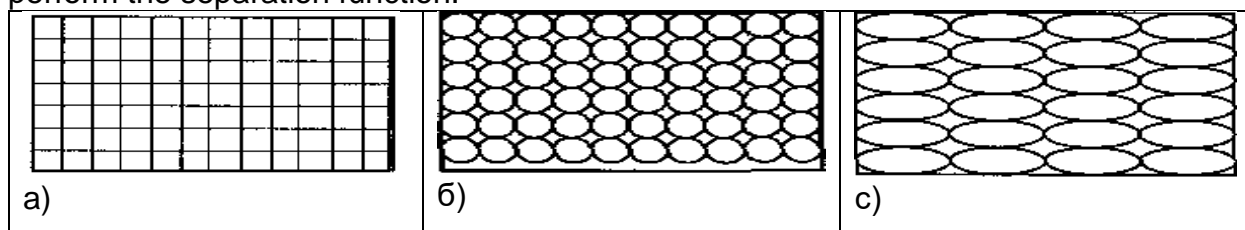
Here: a) woven from steel wire; b), c) made of tin with different holes
Fig. 3. Scheme of types of vibroelasts (mesh surfaces).

Discussion. The advantage of the prepared device is that the cotton moves and cleaning is carried out by vibration of the mesh surface without mechanical impact on the fibers and seeds of the raw cotton. Due to the introduction of new technologies for the primary processing of raw cotton (cleaning with a vibration filter or separator), the natural state of cotton is preserved. In the course of practical experiments on such a device, the following results were obtained: Type of

cotton - Namangan-77, grade 1, moisture in cotton - 8.2%, dirt before cleaning - 2.4%, dirt after the dryer drum - 1.95%, in the proposed device after cleaning - 1.71%, the cleaning efficiency of the device increased from 15% to 20%.

Conclusion. When using the proposed device for production: the natural state of cotton is preserved, the length of the fiber and the seed coat are not damaged. In such a device, the cleaning efficiency can increase by 15-20%, and the number of neps in the fiber obtained from refined cotton can decrease by 40-60%.

References

1. Kh.T. Akhmedkhodjaev, A.M. Salimov, T.O. Toychiev. Technology of preliminary processing of natural fibers. N., 2020, page 288.

2. R. Muradov, E. Tadaeva. Improvement of the design of the cotton cleaning machine: monograph. - N.: "Vadi media" publishing house, 2020. - page 132.

THE PROCESS OF TECHNICAL GRADES OF MEDIUM STAPLE COTTON AT GIN FACTORIES AND ITS ANALYSIS

JURAEVA GULKHAYO

Associate Professor of Namangan Civil Engineering Institute

MURADOV RUSTAM

Professor of Namangan institute of engineering and technology
E-mail.: rmuradov1956@mail.ru, phone.: (+99894) 272-94-56

Abstract:

Objective. In this article, the process of processing industrial grades of medium staple cotton in gin factories and its analysis is considered. Also given is the result requirement according to the standard.

Methods. An analysis was made of the quality of medium-fiber cotton raw materials and its indicators, as well as the degree of damage.

Results. After ginning, the control of the pubescence of raw cotton seeds is carried out according to industry standards. Industry standards are reviewed and updated every five years.

Conclusion. One of the causes of seed damage is that the density of the raw material changes as it increases due to the pressure of the seed comb. It has been studied that some of the saw teeth are broken or the pegs of the seed comb are damaged, causing fibrous seed to come out of the seed. One of its main disadvantages is the mixing of seeds with fibers and seeds, which is manifested by an increase in the distance between the rods.

Keywords: cotton, gin, fiber, process, saw gin, type, class, impurity, effect.

Introduction. That is no coincidence that the cotton industry is at the forefront of global agriculture, requiring sustainable quality performance and broad support for initiatives. These two key metrics - quality and sustainability - often go hand in hand when designing supply chain processes. These indicators, which are the requirements of the current developing period, require the introduction of new and high-quality technologies and the improvement of existing ones. Reforming and researching the design of the cotton gin, which is considered the main link in the cotton ginning process, plays a very important role in improving the quality of cotton fiber.

The competitiveness of cotton fiber in the world market is mainly determined by the length of the fiber, its appearance and the amount of dirty waste in it. For this reason, in the technological process of primary processing of cotton, serious attention is paid to improving the quality of

the fiber. Over the past period, the size and range of cotton produced, its acceptance and initial working conditions have changed, reconstruction work has been carried out at many cotton ginning enterprises, some machines have been replaced that do not meet the requirements of outdated times. In addition, new standards for cotton products are being introduced.

All industrial grades of medium staple cotton are processed in sawmills. One or two rows of gins are installed in the fiber section of the cotton gin, each of which is equipped with one 3KhDDM gin with a UMPD working chamber or two or three 5DP-130 (4DP-130) gins. According to the

"Program for 2021-2022 to increase and radically improve the yield and quality of fiber produced at the cotton processing enterprises of the Uzpakhtasanoat association, it is recommended to install one or two DPZ-180 gins instead of 3KhDDM and 5DP-130 (4DP-130) gins.

Methods. For a continuous supply of cotton to the gins, a hopper can be installed at the end of the distribution auger to collect excess cotton. The performance of the sawmill is determined according to table 1 for industrial grades of cotton. The dirtiness of cotton before cleaning should correspond to the indicators given in table 2.

Table 1

Productivity of a power-saw bench for technical grades of cotton, kg/s

| The type of cotton | Model of the Saw Gin | | | |
	3KhDDM	4DP-130	5DP-130	DPZ-180
Types I and II	780±25	2000±200	2000±200	2800±280
Types III and V	550±25	1200±100	1200±100	1700±170

Usually, productivity is given according to the technical passport of demons. The productivity of the gins is reduced by 10-15% when separating the fiber of selected varieties of cotton that are difficult to clean. When seed cotton is ginned, the gins are set in a "reduced"

mode of operation, that is, the productivity of the gins is reduced by 15-20% when processing all selected types of cotton.

Results. The effect of gin on cleaning impurities and dead cells (K. percent) is determined by the following formula:

$$К = 100 - \frac{S_v \text{x} V}{S_\text{x}}$$

Here: Sx- impurity (mortality) of the cotton coming from the feeder in the gin, percentage; Sv - the amount of impurities (dead) in the fiber after gins, percentage; V- planned fiber output, percentage. The cleaning (replacement) of the raw (raw roller) roller in the working chamber of the gin is carried out, as in the processing of cotton, in one shift:

- first and second grades not less than twice:

- third, fourth and fifth grades at least four times.

After ginning, the control of the pubescence of raw cotton seeds is carried out according to industry standards. Industry standards are reviewed and updated every five years.

Table 2

Soiling of cotton before ginning

Class	Type	Impurity before polishing (from gin), percentage (no more)	
		Normal cleaning	Hard cleaning
1	I	0,8	0,9
	II	0,8	1,0
	III	0,8	1,2
	IV	1,2	1,8
2	I	1,0	1,5
	II	1,0	1,5
	III	1,2	1,8
	IV	1,6	2,4
3	I	1,6	2,4
	II	1,6	2,4
	III	1,8	3,0
	IV	2,4	3,6
	V	3,0	5,0

One of the main requirements for a cotton gin is to obtain a quality product, to prevent damage that can occur during the separation of seeds from the fiber, to achieve high performance of the machine and to ensure maximum cotton yield. In the study of the service life of the saw, the following disadvantages are observed: the appearance of knots in the fiber emerging from it is mainly associated with the breakage or failure of a large number of saw teeth. Seed damage, many defects in fiber content, i.e., seed coat impurities, and the need to make the saw blade very sharp, i.e., the width of the tooth tip should be less than 0.4 mm, were revealed. The positive effect of this invention is that the cultivation of cotton has become much easier. Before Eli Whitney invented the gin machine, ginning was labor intensive, but after this invention, it became easier and faster, and farmers earned more money.When mixed with fibers, a release of the fibers is also observed, and this can be shown to be due to the deviation of the fiber opening from the desired position.It should be noted that the process of developing a genie machine involves a very long period. The modern cotton gin was invented in the United States in 1793 by Eli Whitney (1765-1825). Whitney applied for a patent on October 28, 1793; the patent was issued on March 14, 1794, but not confirmed until 1807.

Discussions. One reason for seed damage is that the density of the raw material changes as it increases due to the pressure of the seed comb. It has been studied that some of the saw teeth are broken or the nap of the seed comb is damaged, causing fibrous seed to come out of the seed. One of its main drawbacks is the mixing of seeds with fiber and seeds, which is manifested by an increase in the distance between the rods. A decrease or cessation of the feed rate of raw materials may be due to a small amount of raw cotton from the supplier or insufficient supply to the working chamber.[1]

Also, due to the increase in the density of the raw material shaft, the fibers remain on the saw teeth or do not separate from the teeth at all, which causes jamming at the bottom of the bars. In addition, one of the main drawbacks of the machines is fiber burnout or sticking at the top of the columns.

According to the researchers, the improvement in the quality of the fiber as a result of the work of the gin in the expanded chamber occurs mainly due to a decrease in the density of the raw material, which improves the coating of the fiber, and reduces the friction force of the cotton on the walls of the chamber. , and saves energy spent on ginning.

They also studied the effect of raw material density during the ginning process

and concluded that fiber quality scores are higher at low raw material density.

According to them, reducing the density of the raw material will improve the coating of the fibers and reduce the frictional forces acting on the surface of the working chamber and columns, thereby improving the quality of the fiber. In existing fiber separation machines, the efficiency is directly proportional to the density of the raw material. [2]

R. Sulaimanov [3] obtained an algorithm for solving the problem of seed movement dynamics and mathematical models that allow theoretically determining the optimal parameters of cantilever columns, the distance between columns and spacers in the production of additional seeds. Basically, the distance between the saws has been reduced, a new method and device for obtaining additional seeds has been proposed.

In the study by J. Ergashev [4], a notch was made in the lower part of the pipe installed in the working chamber of the genie machine. When air is forced into the pipe, the air flow exiting through this slot is directed towards the saw cylinder. As a result, it is possible to increase the amount of fiber sticking to the teeth of the saw cylinder under the influence of air. The air flow directed towards the saw cylinder accelerates the exit of saws separated from the fiber from the working chamber.

Studies have shown that by reducing the saw speed from 730 min^{-1} to 550...620 min^{-1}, the amount of waste and fiber defects can be reduced by an average of 20%.

Conclusion. The main parameters that cause damage to seeds in a cotton gin are determined. Among the parameters to be determined, the stability of the raw material and the speed of its rotation, which are considered the most important, have been carefully studied.

Analyzed studies conducted by scientists to accelerate the stability and turnover of raw materials. Based on the analysis, the rotation of the raw material shaft is accelerated by a rotating disk with piles installed on the side of the working chamber. It was also proposed to prepare the surfaces of the grates with grooves so that the seeds separated from the fiber could be released in a timely manner from the working chamber of the gin.

References

1. Жабборов.Ғ.Ж, Отаметов.Т.У, Ҳамидов.А "Чигитли пахтани дастлабки ишлаш технологияси" Тошкент, "Ўқитувчи" 1987.

2. Зикриёев.Э нинг умумий таҳрири остида "Пахтани дастлабки қайта ишлаш" Тошкент, "Меҳнат"- 2002.

3. Сулайманов Р. Разработка рабочей камеры с улучшенным семявыделением при пильном джинировании хлопка-сырца. Диссертация на соискание учёной степени кандидата технических наук. Ташкент. – 2006 г.

4. Эргашев Ж. С. Совершенствование технологии пильного джинирования с целью повышения количественных и качественных показателей. Диссертация на соискание учёной степени кандидата технических наук. Ташкент. – 1991 г.

LITERATURE ANALYSIS ON THE RESEARCH AND DEVELOPMENT OF THE METHOD OF DESIGNING SPECIAL CLOTHES FOR WORKERS OF METAL CASTING AND METAL PROCESSING ENTERPRISES

XAKIMJONOV ISLAMBEK

Assistant of Namangan Institute of Engineering and Technology
E-mail.: islamsu25@gmail.com, phone.: (+99893) 673-46-69

Abstract: In the article different field worker - worker release for special clothes project on scientific the work take went opportunities and From Uzbekistan of researcher's news learning and books analysis transfer for.

Keywords: industry, worker, special, clothing, classification, model, climate, heat, temperature, particle, dust, fire.

Introduction. Many scientists of foreign countries and Uzbekistan carried out scientific work on the production and design methods of special clothes intended for employees of various fields, the use of materials and the creation of new constructions.

We will analyze the scientific works of scientists from the CIS countries and Uzbekistan, who conducted research on special clothing in various fields for the design of special clothing for workers of metal casting and metal processing enterprises.

R.O. JISLIBAYEVA [1] - In his scientific work, it was studied that he proposed a new concept of designing work clothes based on the application of the theoretical basis of combustion processes to the methodology of designing new types of fire-resistant materials from local raw materials that provide high performance characteristics of work clothes for workers working in the metallurgical industry.

L.G. STUPALOVA [2] - The characteristics of the materials needed to create special clothing that can be used in the design of clothing for workers in various fields are studied, and the possibilities of using them in special clothing models in combination with new materials from leather raw materials, which were rarely used in special clothing before The use of leather raw materials in the process of designing special clothes was proposed and implemented. He worked mainly in the way of designing special clothes for an agricultural enterprise.

E.I. ELAZALI [3] - nomenclature of the most important indicators of quality and safety for insulating non-woven materials used in sewing clothes from low temperatures used in the fuel and energy complex. conducted work on the methodology of determination of conductivity.

In addition, he proposed a method of optical determination of the thickness of non-woven insulating fabrics used in sewing work clothes, and based on the theory of similarity, the change of quality indicators during the washing process of non-woven fabrics used as insulation in work clothes (discontinuity in length and width load, hygroscopicity, total heat resistance) were studied and for the first time in the organizational standard it was proposed to give the values of protection indicators corresponding to 50 washes and reasonable, we used IPS to sew special clothes from low temperature..

T.V. GUSHINA [4] - the laws of the kinetics of the permeability of concentrated and water emulsion forms of pesticides through film polymer materials, numerical values of the durability, permeability and cleaning indicators of film polymer materials after exposure to liquid toxic substances, protection of personal protective equipment against cuts and vibrations comparative data on efficiency, the dependence of protection efficiency on

the presence of a metal core in the glove material, methods of rapid assessment of changes in the protective properties of film polymer material under the influence of pesticides.

N.V. AFINOGENTOVA [5] - taking into account the rheological properties of special materials, physical and mechanical priorities, developed a system of optimal combination of the values of quality criteria with the values of design parameters of overalls in the main informational sections of clothing design.

D.A. SOVETNIKOV - a new nonwoven heat-insulating material was developed. Bicomponent fusion staple with high heat protection properties obtained by combined method has worked on the heat protection properties of packages and top elements to make the tape of suppliers more accurate.

E.E. IGOROVNA - In his scientific work, during the study of the protective, hygienic and operational properties of non-woven fabrics, changes in the physical-mechanical properties of insulation materials, especially the state of fibers during washing, were analyzed. In the course of scientific research, experimental studies were conducted in order to study the protective, hygienic, and operational characteristics of non-woven fabrics using standard laboratory methods. As a result of experimental research, the most important nomenclature of indicators was determined, non-woven insulation materials were recommended for sewing clothes for workers working at low temperatures, and their impact on human life and health was studied.

M.C. NEXOROSHKINA [6] - developed a method of comprehensive assessment of the effectiveness of clothing designed to protect the worker's hands from impact and determined the impact energy with hand tools in production conditions and divided the energy absorbed by the fabric into two components developed a proposal . The first is related to the formation of the fabric, and the second is the impact on the protective ability of the fabric based on the theoretical analysis of the impact energy absorption by the fabric located between the impacting bodies, determining the deformation of the threads in the places where the base and the fabric overlap. the main factors were determined. In addition, he worked on an experimental method for assessing the ability of fabric and material packages to absorb shock energy, and he worked on the proposal of a unit index, which describes the ability of the fabric of special clothing to protect the worker from shock, expressed as a percentage of absorbed shock energy.

Taking into account the specific shape of the structure, an experimental method for determining the flexibility of the structural elements of hand protection equipment was developed, and the hardness of the product was proposed as a comprehensive index describing the relative hardness and quality of hand protection equipment.

In addition to the researchers of foreign countries, many researchers of Uzbekistan also conducted scientific research on the topic of designing special clothes and created optimal options of special clothes for workers in various fields [7].

S.U. PO'LATOVA [8] - The mathematical problem of designing special clothing protecting against high air temperature has been formulated and theoretically solved, and the theoretical basis of heat exchange processes between the hot air environment and the thin layer of clothing has been developed.

S.X. QODIROVA [9] - on the basis of the analysis of the topography of the harmful effects of the production of the special clothing, the connections representing the physico-mechanical and hygienic properties of the antistatic fabrics were developed for the special clothing, which was designed taking into account the opinion of consumers, and for the preparation of the special clothing of the

electrical supply workers. the best option is recommended.

G.D. ULKANBOYEVA [10] - on the basis of biokinematic studies of the builders' movements, the values of the angular parameters of the movements were determined, the relationships between the dynamic effect and the angular parameters were obtained to ensure the dynamic fit of the special clothing structure, and the construction of the builders' safety belt was improved by adding a protective vest. Based on the theoretical possibility of reducing the dynamic load of the safety belt during a fall from a height, at the expense of the recommended safety device, the package of materials was formed in order to increase the operational reliability of the safety vest, and the technological processing ensures its strength by retaining the air inside the vest. introduced the proposal of methods of giving.

N.N. BEBUTOVA [11] - worked on the optimal constructive solution of the "sleeve-o-umiz" structural node, which includes the functional requirements that ensure the freedom of movement of workers during the work process and rationally ensures the air exchange of the underlayer of clothing in hot climatic conditions. created methods for assessing the state of tension of the seams of special clothing details based on the analysis of the failure of the seams with the elastic thread under the influence of loads.

Based on the analysis of the deterioration of the thread connections of special clothing details under the influence of operating loads, recommendations on effective processing technology based on the binding of equal strength thread connections and ensuring the equal strength of the fabric and thread connection, which helps to increase the service life of the special clothing, have been developed .

Conclusion. The above scientific works are focused on the works of foreign researchers on special working clothes in various fields, taking into account the analysis of materials, physical, mechanical, and biomechanical properties, work was carried out to create an optimal option in the design of special clothes. The conducted studies have given importance to the temperature changes of workers in different fields during the production process in different climatic conditions in the process of designing special clothes [12]. But as a result of my studies, there was no work on designing special clothes for workers of metal casting and metal processing enterprises taking into account the climatic conditions of Uzbekistan and the real work process in the enterprise [13].

On the basis of the research, the special clothes of employees of "MEXMASH", "NAMANGANMASH" and "Zamin Metall Sanoat" LLC located in Namangan region were investigated, and defects such as sparks flying from the collar and sleeve parts to the body, accumulation of various particles in the pockets were found [14].

As a result of the conducted scientific analysis, the main goal is to design high-quality special clothing for workers by identifying defects in existing work clothes, taking into account the harmful factors that seriously affect the morale and health of employees of metal casting and metal re-casting enterprises in the work process. was obtained [15].

References

1. Жилисбаева Р.О. "Методологические основы проектирования специальной одежды для работников металлургической и металлообрабатывающей промышленности" диссертация. Москва 2007.

2. Ступалова Л. Г. "Теоретико-методическая модель-концепция формироваш1я структуры исследования исходных проектных данных в системе дизайн проектирования спецодежды", диссертация.

3. Елазали Е.И. "Разработка методов сравнительной оценки нетканых материалов для спецодежды", диссертация.

4. Гущина Т.В. "Улучшение условий труда работников агропромышленного комплекса путем разработки и применения высокоэффективных средств индивидуальной заш1иты рук", диссертация. Санкт-Петербург – 1998

5. Афиногентова Н.В. "Исследование и разработка спецодежды для рабочих автомобильной промышленности" диссертация. Москва 2004.

6. Нехорошкина М.С. "Разработка методов оценки и прогнозирования защитных свойств тканей для спецодежды от ударов" диссертация. Кострома 2015.

7. I.Sh.Xakimjonov "Metallga ishlov berish korxona ishchilari uchun himoya ish kiyimlari uchun materiallarni tanlash."
https://scholar.google.com/citations?view_op=view_ci
tation&hl=ru&user=kxiw77sAAAAJ&citation_for_view=kxiw77sAAAAJ:W7OEmFMy1HY

8. Пулатова С.У. "Агросаноат мажмуаси ишчилари махсус кийимини лойиҳалаш методологияси ва самарали ишлаб чиқариш технологиясини яратиш" диссертация Тошкент-2021.

9. Қодирова С.Х. "Электр таъминоти ишчилари учун антистатик хусусиятли махсус кийим тайёрлаш усулини ишлаб чиқиш" диссертация Тошкент-2021.

10. Улканбоева Г.Д. "Қурувчилар махсус кийими ҳимоя хоссаларини ошириш усулларини такомиллаштириш" диссертация Тошкент-2021.

11. Бебутова Н.Н. "Ўзбекистон агросаноат комплекси ишчилари махсус кийимининг рационал конструкциясини тадқиқот қилиш ва яратиш" диссертация Тошкент-2021.

12. I.Sh.Xakimjonov "Namangan viloyatida joylashgan metall ishlab chiqarish korxonalarida mehnatni muhofaza qilish muammolari va ularning sanoat xavfsizligiga ta'sirini o'rganish" http://wsrjournal.com/index.php/new/article/download/392/276

13. I.Sh.Xakimjonov "Namangan viloyatida mavjud metall ishlab chiqarish va metalni qayta ishlash korxonalarda metallga ishlov berish dastgohi operatori maxsus ish kiyimini o'rganish."https://scholar.google.com/citations?view_op=view_citation&hl=ru &user=kxiw77sAAAAJ&citation_for_view=kxiw77sAAAAJ:YsMSGLbcyi4C

14. I.Sh.Xakimjonov "Analysis of special clothing for workers of metal-working enterprises."https://scholar.google.com/citations?view_op=view_citation&hl=ru&user=kx iw77sAAAAJ&citation_for_view=kxiw77sAAAAJ:d1gkVwhDpl0C

15. I.Sh.Xakimjonov "Maxsus kiyimlar uchun qo'yiladigan xavfsizlik ko'rsatkirlari va umumiy talablar."https://scholar.google.com/citations?view_op=view_citation&hl =ru&user= kxiw77sAAAAJ&citation_for_view=kxiw77sAAAAJ:Tyk-4Ss8FVUC

16. I.Sh.Xakimjonov "Researchung the method of designing special clothing for workers of metal-working enterprises", Academicia AnInternational Multidisciplinary Research Journal (Double Blind Refereed & Peer Reviewed Journal) 2021 6 Iyun

17. I.Sh.Xakimjonov "Metall quyish korxonalari ishlari uchun maxsus kiyimlarni loyihalash usullarini tadqiqot etish", Science community: web of conferences / komunitas sains: web konferens. November-December, 2021 Djakarta, Indonesia

18. I.Sh.Xakimjonov "Maxsus kiyimlar uchun qo'yiladigan xavfsizlik ko'rsatkirlari va umumiy talablar", NamDU Ilmiy axborotnomasi 2021 maxsus son ISSN-2181-1458.

19. I.Sh.Xakimjonov "to study the current state of heat-protected fabrics", Science and Education in Karakalpakstan. 2021 №4/3 ISSN 2181-9203.

20. I.Sh.Xakimjonov, Go'zaloy Y., Robiyabonu M "Namangan viloyatida joylashgan metall quyish, metallni qayta ishlash korxonalarida ishlab chiqariladigan mahsulotlar tahlili va ishlab chiqarishda maxsus kiyimni o'rni", Fan va ishlab chiqarish integratsiyalashuvi sharoitida to'qimachilik va engil sanoatdagi muammolar va ularni bartaraf etish yo'llari: halqaro ilmiy-amaliy konferensiyasi maqolalari to'plami. 1-Tom. –Namangan: NamMTI, 2022.

GROWING, STORAGE, PROCESSING OF AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

UDC 664.8(035)

IMPROVING THE TECHNOLOGY OF PRODUCTION OF FUNCTIONAL NUTRITION JUICES

KHODJIEV ADHAMJON

Doctoral student of Namangan Institute of Engineering and Technology
E-mail.: xodjiyev1991@bk.ru, phone.: (+99891) 368-19-91

CHORIEV ABDUSATTAR

Associate Professor of Tashkent Technical University named after I.Karimov
E-mail: choriyev@gmail.com, Phone.: (+99897) 739-82-75

RAXIMOV UMIDJON

PhD of Namangan Institute of Engineering and Technology
E-mail.: rumid8887@mail.ru, phone.: (+99893) 402-00-33

Abstract:

Objective. The chemical composition and useful substances of carrot and lemon juices for human life have been studied. The technology of blended juice production is investigated.

Methods. Today, large-scale work is underway to further expand the technology for the production of functional edible juice from these fruits, such products are very useful for the human body.

Results. Carrots after delivery, acceptance, storage, inspection, washing, cleaning and cutting were blanched with steam and pressed. The yield of carrot juice was 55%, respectively. Lemon fruits were also pressed after inspection, washing, cutting and crushing. To obtain a blend , the juices were mixed in the following ratios: 3:0,5; 2:0,5; 1:0,5 (carrot – lemon).

Conclusion. The resulting blended juice does not cause any side effects and its production can be introduced for the treatment of sick people.

Keywords: carrot, lemon, vitamin, carbohydrates, proteins, minerals, technology, disease.

Introduction. In the global food industry, scientific research is being conducted on the processing of raw materials rich in carbohydrates, proteins, minerals, vitamins, organic acids, polyphenols and the production of high-quality beverages from them. Special attention is paid to the measures carried out in this direction for the rational use of natural raw materials and products at industrial enterprises, increasing the production of new types of products, reducing the cost of finished products, increasing food, biological and energy values and providing the younger generation with high quality and safe natural products. Significant results have been achieved in improving the technical and economic indicators of the country's food industry through the production and storage of fruit and vegetable products, plant raw materials, safe for health, import-substituting new types of food products in the required quantity and assortment. The Strategy of Actions for the Further Development of the Republic of Uzbekistan sets the tasks of "raising industry to a qualitatively new level, deep processing of local raw materials, accelerating the production of finished products, mastering new types of products and technologies. In this regard, evaluating the quantity and efficiency of the use of raw materials, updating existing recipes and technologies, introducing them into production, obtaining high-quality products, preserving the natural properties of products, improving the quality of finished products and

expanding the range of food products using important traditional raw materials. It should be noted that fruits and vegetables, as well as their processed products (especially natural juices) contain a large amount of carbohydrates, protein substances, organic acids, vitamins, minerals, etc. Due to this, they have both nutritional and dietary (therapeutic) value [1-3]. Therefore, they are used for the prevention and treatment of various diseases of the gastrointestinal tract, liver, kidneys, cardiovascular diseases, atherosclerosis and other metabolic disorders.

Carrot is a vegetable crop, belongs to the umbrella family. Unpretentious in cultivation, it grows in different climatic zones. It is divided into a feed and a dining room. In cooking, a dining room is used, which has about 60 types. On sale you can find not only orange, but also yellow, pink, white, purple, green, even black carrots. It contains 87% water, carotene, which is converted into vitamin A in the human body, phytoncides — suppress the action of microbes. Carrots contain vitamin C, iron, thiamine, calcium, magnesium, phosphorus, sulfur, glucose, fructose, interchangeable and essential amino acids, polyunsaturated fatty acids, proteins – 1.4 g (g / 100 g), carbohydrates - 7 g (g/ 100 g). Lemon is a hybrid of citrus and bitter orange. The birthplace of lemon is unknown, but scientists tend to believe that this plant appeared in India or China. For centuries in Asia, lemons have been used as an antiseptic and an antidote for various poisoning. Lemons contain carbohydrates, proteins and some fats (essential oils). In the pulp of lemons there is a large amount of organic acids: citric, malic, ascorbic, also proteins - 0.9 g per 100 g, fats - 0.1 g per 100 g, carbohydrates - 3 g per 100 g. The main value of lemons is a high content of vitamin C and a complex of vitamins of group B. From micro- and macroelements in lemons, contain calcium, iron, magnesium, phosphorus, potassium and zinc. It is proved that special environmentally friendly raw materials should be used to produce functional food products. In the production of baby food products, the problem of providing environmentally friendly and high-quality raw materials is urgent. The real danger for consumers is the contamination of products with heavy metals from emissions from industrial enterprises, transport, the use of toxic chemicals and fertilizers, as well as the use of antibiotics in animal husbandry and veterinary medicine in the cultivation and fattening of animals [8-15].

Lemon is used in folk medicine in many countries for the treatment of various diseases: scurvy, jaundice, dropsy, kidney stones, palpitations, gastric catarrh, hemorrhoids, acute rheumatism, gout, aches and lumbago. Lemon fruits are an effective treatment for diabetes mellitus and other diseases accompanied by metabolic disorders. The pectin substances contained in lemon have the ability to remove heavy metals from the body. Lemon peel also has healing properties, which strengthens the gums, eliminates yellow plaque on the teeth and prevents nail delamination. A light massage with lemon juice helps to relieve leg fatigue. With the help of this fruit, you can also cope with calluses and soften roughened skin areas. In Uzbekistan, there are the main varieties of lemon fruit, and the city of Tashkent, Namangan region is also adapted to the cities of Andijan and Fergana.For drying, ripe fruits with a dense structure are selected. as a result, dried fruits change .in dried fruits, the accuracy of the information is lost, and the dried fruits of bitter, but sugary varieties taste good [5].

After a difficult transition period to market relations, the volume of functional nutrition production in Uzbekistan began to increase again.

In recent years, a number of measures have been implemented in Uzbekistan to expand the production of functional nutrition products, for example, multicomponent canned products. Their

composition corresponds to the specifics of metabolism of different ages, contributes to the expansion of the assortment of canned food and increases the nutritional and biological value of daily diets. A comprehensive program is being implemented in the country to create biologically complete high-quality products for healthy and sick people of different age groups with the involvement of employees of academic and industry research institutes in new developments.

Methods. Increasing the volume of production of baby food products is possible through the introduction of new technological methods and techniques, improving the quality of products in accordance with the Law of the Republic of Uzbekistan "On the quality and safety of food products".

Results. The resulting blended juices had a dark red color and a pleasant sweet and sour taste. The tasting committee unanimously noted the best indicators of the third variant of blended juice 1:0.5 (carrot – lemon). This batch of blended juice was bottled, capped and sterilized after packaging.

After cooling to 45 0C, canned food was stored in the laboratory at room temperature and relative humidity up to 75-80%. Thus, as a result of our research, we have developed a technology for producing blended juice from carrots and lemon (Fig. 1). To prevent marriage and microbiological contamination of canned food, it is enough to sterilize them at a temperature of 1000C [6-7].

Discussions. Blended carrot and lemon juice is recommended for non-drug treatment of various diseases of the gastrointestinal tract, liver, kidneys, anemia, neurosis, insomnia, atherosclerosis and other metabolic disorders.

Blended juice is recommended to be consumed 150-200 cm3 three times a day 15-20 minutes before meals for 1-2 months as a dietary (therapeutic) product for non-drug treatment of the above diseases [5].

Conclusion. The resulting blended juice does not cause any side effects and its production can be introduced for the treatment of sick people.
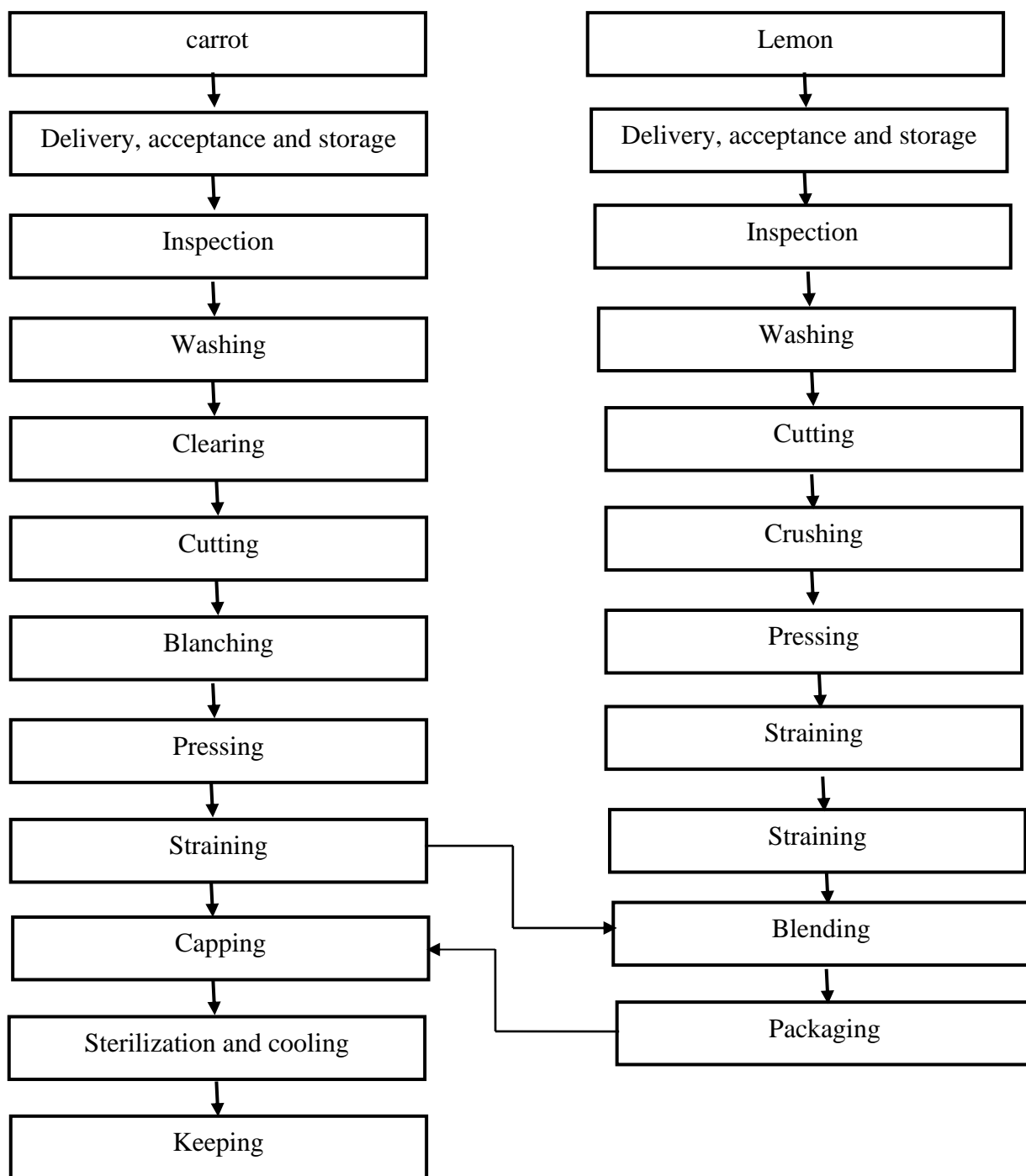
Fig.1. Technology for obtaining blended juice from carrots and lemon

References:

1. Omarov M. M. Technology of production of dietary (medicinal) products from fruit and vegetable and medicinal raw materials of Dagestan / M. M. Omarov. –Makhachkala: DSTU, 2009. – 179 p.

2. Encyclopedia of folk methods of treatment. – St. Petersburg: SPIX, 1994. -357s.

3. Omarov M. M. Technology of production of blended juice from carrots and table beets / M. M. Omarov, M. N. Islamov, Z. A. Abdulkhalikov // Beer and beverages. – 2013. – № 5.

4. Ashhurst F.R., Hargitt P. translated from English, Practical recommendations for manufacturers of soft drinks and juices, – St. Petersburg: Profession, 2010. – 215 p.

5. SanPiN 2.3.2.1078-01 /Hygienic requirements for the safety and nutritional value of food products.

6. Nikitina E.V. Microbiology, Giord, – SPB, 2009, – 360c.

7. Omarov M. M. A new dietary product from root vegetables and lemon /Food industry. – 2015. – No. 2.

8. Production of environmentally friendly baby food products //Tez. dokl. nauch.-prakt.konf. – M.: 1994

9. Safety of food raw materials and food products: Textbook / I. A. Rogov, N. I. Dunchenko, V. M. Poznyakov, A.V. Berdutina, S. V. Kuptsova. — Novosibirsk: Sib. univ. publishing house, 2004. ~ 227 p.

10. Donchenko L.V. Safety of food raw materials and food products /L.V. Donchenko, V.D. Nadytka / -M.: Food industry. -1999. - 352s.

11. Adxam X., Abdusattar C. RESEARCH OF DRIED DATES PRODUCTION TECHNOLOGY //American Journal of Interdisciplinary Research and Development. – 2022. – Т. 6. – С. 88-91.

12. Jumaeva, D., Toirov, O., Okhunjanov, Z., Raximov, U., & Akhrorova, R. (2023). Investigation of the adsorption of nonpolar adsorbate molecules on the illite surface. Journal of Chemical Technology and Metallurgy, 58(2), 353-359.

13. Raximov U. Yu., Jumaeva D.J. Investigation of physico-chemical properties of thermally activated adsorbents on the basis of local waste //НамИТИ Научный-технический журнал. – 2021. – №. 2. – С. 92-97.

14. Juraevna, D. J., Yunusjonovich, U. R., & Karimovich, O. E. (2022). Studying on the activated absorbents derived from waste of a grape seed. Journal of Chemical Technology and Metallurgy, 57(5), 998-1005.

15. Raximov U. Yu., Jumaeva D. J., Aymurzaeva L. G. Investigation of the physicochemical properties of steam-activated adsorbents// Uzbek chemical journal, 2021. №5. С. 44-50.

UDC 664.8

RESEARCH IN BEVERAGE TECHNOLOGY INTENDED TO SUPPORT THE FUNCTIONS OF THE CARDIOVASCULAR SYSTEM

NISHONOV UTKIRALI

Assistant of Namangan Institute of Engineering and Technology
E-mail: nishonov84@inbox.ru, Phone: (+99893)4030612

Abstract:

Objective. Currently, research on the creation of technology for food products enriched with biologically active additives of plant origin continues to be relevant. In this regard, of interest are plants containing polyphenolic compounds, which indirectly through enzyme systems regulate redox processes that determine the state of the cell membrane. From this point of view, prostrate marigolds (Tagetes patula L.) are a raw material source with a rich and diverse composition of polyphenols. Infusions and decoctions of marigolds are widely used in folk medicine as antimicrobial, hypotensive, hepatoprotective and diuretic agents.

It is also timely and important to develop a technology for obtaining preventive drinks with the addition of biologically active additives of plants of the genus Tagetes (Asteraceae) and some other families characteristic of plants.

Methods. The relevance of this work lies in the study of the chemical composition of inflorescences, as well as the study of enriched drinks.

Inflorescences of prostrate marigolds *(Tagetes patula L.)* are a valuable source of biologically active substances (BAS), mainly flavonoids, which is confirmed by studies devoted to the study of both the chemical composition and the pharmacological activity of various fractions and isolated individual substances. Of interest is also the complex use of inflorescence meal as an additional source of biologically active compounds.

Results. Given the above, we considered it appropriate to conduct a comprehensive study of the inflorescences of prostrate marigolds *(Tagetes patula L.)*, as well as to develop a technology for obtaining prophylactic drinks based on it, which in fact is the goal of our research.

In connection with this goal, we considered it expedient to solve a number of problems. To solve the tasks set, it is supposed to use modern chemical and physico-chemical methods of research.

Conclusion. The scientific novelty of the study lies in the fact that an in-depth study of the chemical composition of the extract obtained by extraction with ethyl alcohol 40% was carried out. The choice of extractant for this object is substantiated. For the first time, a technology has been developed for obtaining prophylactic drinks with the addition of biologically active additives of prostrate marigold inflorescences *(Tagetes patula L.)*.

Keywords: drinks, cardiovascular system function, flavonoids, cardioprotective and hepatoprotective actions, marigolds.

Introduction. A review of the works of domestic and foreign literature on the chemical composition and pharmacologically active components of the inflorescences of prostrate marigolds *(Tagetes patula L.).* The chemical composition of the most common plant species of the genus Tagetes is represented by a rich set of biologically active substances belonging to various classes of organic compounds.

Methods. To determine the biologically active substances in the composition of this plant, the method of highperformance chromatography was used. Ethyl alcohol was chosen as the solvent.

There is information about the structure and pharmacological activity of some flavonoids specific to plants of the genus Tagetes. For example, antioxidant, anti-inflammatory, and antitumor activities have been proven for quercetagetin and patulithrin [1, 2].

The essential oil obtained during the processing of Tagetes minuta L. marigold flowers is used in the perfumery and cosmetics industry. For the prevention of viral infections and acute respiratory diseases, a homeopathic oil-based preparation "Tageton" is used [3].

Carotenoids from the flowers of Tagetes erecta L. - lutein and zeaxanthin are used as biologically active additives [4].

In the roots of three marigold species *(Tagetes patula L., Tagetes erecta L., Tagetes tenuifolia Cctv.)*, thiophene derivatives with fungicidal properties were found. Some works provide data on their accumulation in the flowers of prostrate marigolds. It is possible that the presence of this class of compounds is responsible for the antimicrobial activity of flowers [5].

Studies were carried out on the flavonoid composition of the seeds of Tagetes patula L. *(short and tall forms)*, and patuletin and patulithrin were isolated by preparative column chromatography. Quercetagetin and quercetagitrin were isolated from the seeds of Tagetes erecta L.

A method has been developed for the simultaneous production of patuletin and patulithrin from plant materials.

Isoquercitrin, quercimerythrin, isorhamnetin and its glycoside, as well as derivatives of quinic acid, have been isolated from different parts of marigold prostrate inflorescences.

The chemical composition, biological and pharmacological activity of flowers of prostrate marigo lds Tagetes patula L. variety "Orange" were studied at the Department of Organic Chemistry of Pyat GFA. It was proved that the main flavonoids in marigold flowers are patuletin and patulithrin, and their preparative isolation was carried out. The content of

flavonoids in raw materials in terms of patuletin is 9.43% [6].

The presence of rutin, quercetin, dihydroquercetin, robinin, luteolin-7-glucoside, vicenin, vitexin, hyperoside and apigenin has also been proven; studied vitamin, amino acid composition, polysaccharide complex, as well as the content of macro- and microelements of various fractions [6].

The hepatoprotective activity of sums of flavonoids containing mainly flavonol patuletin has been experimentally proven. According to the totality of the identified biochemical parameters, the histological and morphological picture of the liver, this amount is several times higher than the action of Karsil in an equivalent dose [7, 8].

It has been shown that the use of flavonoids from the flowers of marigold prostrate for therapeutic and therapeutic and prophylactic purposes contributes to a more effective preservation and restoration of the pro/antioxidant balance, an increase in the efficiency of detoxification, and also enhances antioxidant protection. A more pronounced stimulating effect on the processes of bile formation and bile secretion was established than with a similar use of Karsil [9].

The antimicrobial activity of substances from marigold flowers was studied and it was found that the extract obtained with ethyl alcohol 70% has a bactericidal and bacteriostatic effect against certain types of bacteria.

It has also been established that extracts from the flowers of marigold procumbent exhibit a gastroprotective effect in conditions of experimental gastropathy in rats [10, 11].

Theoretically substantiated and experimentally developed the technology of extraction of marigold prostrate flowers, which allows extracting lipophilic substances characterized by a wide range of biological activity. Ethyl alcohol 70% was used as an extractant. Based on these studies, a technology was developed for obtaining capsules containing a dry extract of marigold flowers and quercetin with an optimal dosage of both components, and methods for their standardization were proposed. An experiment on laboratory animals showed that the resulting capsules completely prevent the activation of lipid peroxidation in the liver when it is damaged by carbon tetrachloride.

Granules containing dry and oily extracts from marigold flowers were obtained by wet granulation.

Marigold prostrate is known for its phytochemical and medicinal properties. Infusions and decoctions of flowers are used in folk medicine and homeopathy in the treatment of diseases of the upper respiratory tract, as an antimicrobial, antiseptic. hypotensive, diaphoretic and diuretic. In addition, marigold flowers are eaten, added to refreshing drinks in Latin America and Georgia. Patuletin is part of dietary supplements, for example, "Hepatoleptin", is used as a means of improving the functional state of the liver and biliary tract. Used for prevention and in the complex therapy of cholecystitis, cholecystocholangitis, cholangitis and cholangiohepatitis [12].

Antioxidant activity of flavonoids

Flavonoids are among the widely distributed natural polyphenols. increased interest in which can be explained by their exceptionally unique properties. They have a wide range of pharmacological activity, including: antioxidant, antiviral, hypoglycemic, immunomodulatory activity. From the point of view of the practical use of flavonoids, their antioxidant properties are of the greatest interest.

In addition, many representatives of this class are able to act as agents that prevent or inhibit the formation of tumors, strengthen blood vessels, protect the liver and gastrointestinal tract, stimulate the brain and heart.

Flavonols - kaempferol, luteolin, quercetin, myricetin, containing from two to six phenolic OH groups, are 2-4 times superior to Trolox in their ability to inhibit peroxide radicals.

It is known that quercetin and luteolin at the same high level contribute to the neutralization of hydrogen peroxide, inhibit the generation of superoxide anion radical, which plays a key role in the formation of other reactive oxygen species, and inhibit membrane lipid peroxidation.

Numerous experimental studies have made it possible to determine the most important structural fragments of flavonoids for antioxidant activity: firstly, the presence of ortho-dihydroxy groups in the C3' and C4' positions, which is the most preferable target for radical attack. Secondly, it is a system that includes a vinylene group in the C2-C3 position and a carbonyl in the C4 position, which, together with the "B" aromatic nucleus, essentially constitute the main conjugation chain in flavones, flavonols and chalcones. It is the main conjugation chain that is responsible for the transfer of electronic effects from the "B" ring to the chromon nucleus. Thirdly, the presence of hydroxy groups at positions C3 and C5, together with a carbonyl group at position C4, ensure efficient binding of iron ions (Fe^{3+}) and inhibition of the radicals formed in the reactions of hydroperoxide decomposition.

Due to the balanced work of the enzymatic and non-enzymatic link of the antioxidant system in a healthy body, the intensity of lipid peroxidation and the level of free-radical and peroxide oxygen forms are maintained.

Thus, flavonols, due to the above three structural groups important for antioxidant activity, as a rule, exhibit the highest antioxidant activity in in vitro studies.

Endothelioprotectors

It is known that endothelial dysfunction is one of the main causes of development of almost all cardiovascular diseases. This is a universal pathophysiological process, which is associated to some extent with a number of diseases, including socially significant ones, such as atherosclerosis, arterial hypertension, diabetes mellitus, and cerebrovascular accident [13].

When the endothelial mechanism of regulation of cerebral hemodynamics is disrupted, the balance in the systems "vasodilators - vasoconstrictors" and "antiaggregants - proaggregants" is shifted, as a result, there is a shift in vascular tone towards vasoconstriction and an increase in blood thrombogenic potential, which can aggravate the course of ischemic stroke. The normal state of the endothelium of the cerebral vessels, on the contrary, ensures an equilibrium state in the listed systems (vasodilating and antithrombotic functions of the endothelium), thereby ensuring an adequate blood supply to the brain.

One of the many applications of polyphenolic compounds is the correction of endothelial dysfunction. It is known that the initiation of free radical processes with overproduction of toxic peroxynitrite lies in the etiopathogenesis of vascular endothelial dysfunction.

Pathogenetic factors lead to an imbalance between pro- and antioxidants in the body, which leads to an increase in the number of free radicals and, as a result, to an excessive accumulation of toxic products. For example, the development of vascular complications in diabetes mellitus can be prevented or slowed down with the help of antioxidant therapy [14, 15, 16, 17].

The cause of vascular complications in diabetes mellitus is developing endothelial dysfunction, in which there are disturbances in the system of synthesis and availability of nitric oxide (II) [18].

Results. It is known that flavonoids - quercetin, hesperidin, flavicin - can indirectly influence the production of endogenous nitric oxide (II), improve the vasodilating and antithrombotic function of the endothelium, blood rheology and microcirculation, have a stimulating effect on angiogenesis and collagen formation in the wound, as a result of which healing will be accelerated. wounds. Their positive effect on carbohydrate and lipid

metabolism in animals with experimental diabetes mellitus was studied [18, 19, 20].

In addition to their direct cytotoxic properties, free radicals can attract various inflammatory mediators, contributing to the prolongation of the inflammatory response and tissue damage. Flavonoids, in this case, inhibit lipoxygenase, which reduces the duration of inflammation in wound areas.

Flavonoids have a complex pharmacological activity, the ability to influence various links in the development of endothelial dysfunction: the system of synthesis, excretion and bioavailability of NO, hemorheological parameters of blood, lipid and carbohydrate metabolism, inflammation, and proliferation.

The use of flavonoids as antioxidant and endothelioprotective agents is promising in the treatment of wounds, since they are able to stabilize the production of endogenous nitric oxide by the constitutive form of synthase and additionally prevent the increased formation of free radicals [13].

Discussions. The advantages of biologically active substances of plant origin are obvious for many reasons, so the search for endothelial protectors among them is a promising direction in the field of pharmacy and medicine. Given the above, prostrate marigolds are a promising source of flavonoids containing highly active flavone derivatives - patuletin and patulithrin.

Marigold flavonoids inhibit inflammation, expression of inducible nitric oxide synthase (iNOS), prostanoids and leukotrienes, as well as other mediators of the inflammatory process (some cytokines and chemokines).

Recent studies have shown the immunomodulatory effect of patuletin, in particular in relation to TNF-α (tumor necrosis factor). In addition, anti-arthritic activity was revealed due to the effect on the production of anti-inflammatory cytokines [21].

Thus, the existing information on the chemical composition of the inflorescences of marigold procumbent allows them to be used as a raw material for the production of biologically active substances with endothelioprotective activity.

Conclusions. From a review of the literature, inflorescences of prostrate marigolds are a valuable source of biologically active substances, mainly flavonoids. This is confirmed by the results of many works devoted to the study of both the chemical composition and the pharmacological activity of various fractions and isolated individual substances. It can be taken into account that the composition of various fractions from marigold flowers contains polyphenols. It has been proven that the purified complex of flavonoids, containing mainly the flavonoid patuletin, exhibits a hepatoprotective effect, which prevents the activation of lipid peroxidation in the liver when it is damaged by carbon tetrachloride. Thus, the enrichment and creation of recipes for preventive drinks using biologically active additives of this plant material has a beneficial effect on the health of the population.

References

1. Рогинский, В.А. Фенольные антиоксиданты. –М.: Медицина, 1988. –247 с.

2. Cai, Q. Dietary flavonoids, quarcetin, luteolin and genistein, reduce oxidative DNA damage and lipid peroxidation and quench free radicals / Q. Cai, R.O., K. Zhang // Cancer Lett. –1997. –Vol. 119, No1. –P. 99-107.

3. Растительные ресурсы СССР: Цветковые растения, их химический состав и использование/ под ред. А.Д. Соколова. –Л.: Нева, 1980. –С. 16-20.

4. Новые каротиноидсодержащие фитопрепараты / П.П. Ветров [и др.] // Провизор. –2000. –No16. –С. 19-20.

5. Папаяни, О.И. Изучение антимикробного действия некоторых субстанций из цветков бархатцев распростертых / О.И. Папаяни, И.И. Клишина // Разработка, исследование и маркетинг новой фармацевтической продукции: сб. науч. тр. – Пятигорск, 2010. –Вып. 65. –С. 485-486.

6. Подгорная, Ж.В. Исследование цветков бархатцев распростертых (TagetespatulaL.) с целью получения биологически активных веществ: дис. ... канд. фарм. наук: 15.00.02. / Подгорная Жанна Валерьевна –Пятигорск, 2009. –145 с

7. Василенко, Ю.К. Гепатозащитные свойства препаратов из бархатцев распростертых / Ю.К. Василенко // Хим.-фармац. журн. –1990. –Т.24, No1. –С.53-56.

8. Терехов, А.Ю. Изучение терапевтического действия флавоноидов Tagetespatulaпри хроническом поражении печени у крыс / А.Ю. Терехов // Разработка, исследование и маркетинг новой фармацевтической продукции: сб. науч. тр. –Пятигорск, 2005. –Вып. 60. –С. 425-428.

9. Влияние патулетина из цветков бархатцев распростертых на состояние эндогенной антиоксидантной системы / Е.Г. Доркина [и др.] // Разработка, исследование и маркетинг новой фармацевтической продукции: сб. науч. тр. – Пятигорск. –2007. –Вып. 62 –С.464-467.

10. Изучение гастропротекторного действие БАВ из цветков бархатцев распростертых в условиях экспериментальной язвы желудка / Е.Г. Доркина [и др.] // Разработка, исследование и маркетинг новой фармацевтической продукции: сб. науч. тр. –Пятигорск. –2008. –Вып. 63 –С.414-416.

11. Изучение химического состава и влияния экстракта из цветков бархатцев распростертых на про/антиоксидантное равновесие в желудке крыс при вольтареновой гастропатии [Электронный ресурс] / О.И. Папаяни [и др.] // Современные проблемы науки и образования. –2012. –No1. –Режим доступа: https://www.science-education.ru/ru/article/view?id=5618.

12. Кьосев, П.А. Полный справочник лекарственных растений / П.А. Кьосев. – М.: ЭКСМО –Пресс, 2000. –С.437-438.

13. Эндотелиопротекторы –новый класс фармакологических препаратов / И.Н. Тюренков, А.В. Воронков, А.А. Слиецанс, Е.В. Волотова // Вестн. Рос. акад. мед. наук. –2012. –No7. –С.50-57.

14. (14) Бондарь, И.А. Антиоксиданты в лечении и профилактике сахарного диабета / И.А. Бондарь, В.В. Климонтов // Сахарный диабет. –2001. –Т.4, No1. –С. 47-52.

15. (19) Верткин, А.Л. Роль современных сахароснижающих и антиоксидантных препаратов в фармакотерапии сахарного диабета 2-го типа и его осложнений / А.Л. Верткин // Леч. врач. –2009. –No3. –С. 69-73

16. (68) Мисникова, И.Р. Актуальные вопросы профилактики сахарного диабета 2-го типа / И.Р. Мисникова, А.И. Древаль // Врач. –2014. –No3. –С.83-84.

17. (98) Слиецанс, А.А. Изучение эндотелиопротекторных свойств флавоноидов при экспериментальном сахарном диабете: автореф. дис... канд. фармац. наук: 14.03.06. / Слиецанс Анна Альбертовна –Пятигорск, 2011. –24 с.

18. (97) Слиецанс, А.А. Заживление ран и их кровоснабжение у крыс с сахарным диабетом при блокаде индуцибельной и конститутивной NO-синтаз / А.А. Слиецанс, Е.М. Ломкина, И.Н. Тюренков // Вестн. ВолгГМУ. –2013. –No1 (45). –С.37-49.

19. (141) Potential of flavonoids as anti-inflammatory agents: modulation of pro-inflammatory gene expression and signal transduction pathways / M.J. Tuñón [et al.] // Current Drug Metabolism. –2009. –Vol. 10, No3. –P. 256-271.

20. (143) Rasik, A.M., Shukla, A. Antioxidant status in delayed healing type of wounds / A.M. Rasik, A. Shukla // Int. J. Exp. Pathol. –2010. –Vol.81. –P. 257-263.

21. (84) Пат. US2015/0025131 A1 Patuletin a potent anti-TNF-a and anti-arthritic compound from Tagetes patula[Электронныйресурс] / Muhammed Ahmed Mesaik, Almas Jabeen et al. –USA No13/944,387; заявл. 17.07.2013; опубл. 22.01.2015. –5 с. –Режим доступа: http://www.freepatentsonline.com/y2015/0025131.html

22. Saribaeva D.A., Zokirova M.S., Kholdarova G.A. Researching the technology of making beverages of containing fruit juice // Universum: technical sciences: electron. scientific magazine 2022.1(94). URL: https://7universum.com/ru/tech/archive/item/12981 (date of access: 10/22/2022).

23. Saribaeva D.A., Zokirova M.S. Study of the elemental and amino acid composition of ginger // Universum: technical sciences: electron. scientific magazine 2021. - No. 11(92). - with. 86-91.

24. Saribaeva D.A., Kholdarova G.A. Study of the processes of obtaining functional drinks based on the extract of milk thistles (Silybum marianum L.) // Universum: technical sciences: electron. scientific magazine 2022.11(104). URL: https://7universum.com/ru/tech/archive/item/14641 (date of access: 12/20/2022). Z

UDC 10167

DEVELOPMENT OF NEW TYPES OF VEGETABLE JUICES AND BEVERAGES TECHNOLOGY

VOKKOSOV ZUHRIDDIN

PhD of Namangan Institute of Engineering and Technology
E-mail: zukhriddinvoqqosov@gmail.com, phone: (+99899) 973-94-30

HAKIMOV SARDORBEK

Master's student Namangan Institute of Engineering and Technology

Abstract:

Objective. In this article, vegetables such as cucumbers, carrots, and cabbage are given in different amounts The effect of enzymes such as Pectomaserin, Pectinex Ultra SP-L, Pectomaserin G10X, Fructozyme M and increased juice output in juice production. The effect of the type of vegetables was determined, it was studied the development of original technologies of cucumber, carrot, cabbage juices and drinks .

Methods. In our republic, vegetable juices are produced in a much smaller volume and assortment than fruit and vegetable juices, and modern methods such as enzymatic processing and targeted lactic acid fermentation are practically not used to obtain them. The prospects of these methods allow not only the use of cost-effective technological modes and the saving of energy resources, reduction of losses and waste, but also the possibility of "soft" modification of the components of raw materials to obtain quality products . Cucumbers, cabbage and carrots were used as the main raw materials for laboratory work for scientific research. The main chemical composition of these raw materials was determined.

Results. Cucumbers, carrots, and cabbage are selected raw materials under the influence of Polygalacturonase, which breaks down pectin and reduces the viscosity of the juice. It increased 10-15 times when using Fructozyme M and Pectomaserin G10X, and only 7 times when using Pectinex Ultra SP-L. At the end of exposures with FP Fructozyme M and Pectomaserin, the viscosity increased 4-6 times, and with Pectinex Ultra SP-L, others showed that the activity of the enzyme in sample 1 was from 8 to 13, and the activity of the second sample was from 11 to 14 it has been.

Conclusion. It was determined that it is expedient to use enzymatic methods to obtain juices and drinks with high nutritional value from cucumbers, carrots and white cabbage, Pectomaserin G10X and Fructozyme M - to obtain purees and juices with stable pulp, Pectinex Ultra SP-L - from finely ground pulp

to better separate the juice; improved the classification of macerating preparations. In the market economy of production and finished products, it was calculated that 1 ton of finished products is equal to 2,497,225 soums

Keywords: Pectomaserin, Pectinex Ultra SP-L, Pectomaserin G10X, Fructozyme M, cucumber, carrot, cabbage, juice.

Introduction. The development of food industry, safety, and product processing technologies is of great importance in satisfying human needs. These products include vegetable juices and drinks, which are part of many diets, have a low calorie content and contain a complex of biologically active substances: vitamins, minerals, prebiotics, dietary fiber, natural antioxidants.[1-3] However, the analysis of the domestic juice market and practical technologies shows that vegetable juices are produced in a much smaller volume and range than fruit juices, and modern methods such as enzymatic processing and targeted lactic acid fermentation are practically not used to obtain them. The prospects of these methods are related not only to the use of cost-effective technological modes and the saving of energy resources, the reduction of losses and waste, but also the possibility of "soft" modification of the components of raw materials to obtain quality products . In this regard, the improvement of technological processes and the creation of new formulations of vegetable juices and drinks that provide high nutritional value, functional activity and organoleptic qualities are among the priorities of scientific research.

Since the beginning of the 21st century[4,5], the physiological norms of annual consumption of vegetables per capita in Uzbekistan (total 113.3 kg; of which cabbage 2.1, tomatoes 25.6, cucumbers 5.5, onions and garlic 18.3, carrots 18 ,3, beets 5.5, other vegetables 20.0 kg), vegetable growing is being developed rapidly. Districts around large cities and industrial centers mainly deal with S. In the company, dekhdon and farms, the cultivation of fairy vegetables in the open field under polyethylene films has been started. Gen. of the Republic. the cultivation of vegetables was not developed in the regions. Foreign varieties and experiences are widely used in S. In 2000, the area of vegetable crops in Uzbekistan was 130.4 thousand ha, the gross harvest was 2637.3 thousand tons, and the yield was 173.1 s/ha.

The following methods are used to extract fruit and vegetable juices: 1. Physical methods - the chemical composition and properties of the product do not change. These methods include settling, filtering, centrifugation, electroseparation, lighting with bentonite clay.

In colloid-chemical methods, the colloidal system of juices is destroyed. Such methods include gluing (gluing), coupling, thermomethods (rapid heating, freezing and melting), working with coagulants (alcohol), adding bentonite clay [5].

Chemical methods are based on the combination of natural substances in the juice with each other or with an added chemical reagent. Some lighting methods are combinatorial. For example, when juices are cooled, chemical reactions occur between additives and proteins, along with a process of self-lightening under the influence of enzymes.

The use of enzymes that increase the amount of juice in juice production, the following enzyme preparations are used in all countries: pectavamorin, pectofoetidin, bostrin PEP-1 (Bulgaria), ultrazym (Romania), filazim (Hungary), pectinol (USA), panzym (Germany) and others [6].

Working with electricity. The method was developed by Flaumenbaum and is based on the destruction of protoplasm when an electric current is passed from fruits and vegetables or pulp. As a result, cell permeability and juice output increases.

Methods. *[7-10]* In order to quickly and easily achieve the intended goal in carrying out scientific research and performing experiments, first of all, it is necessary to know how to correctly choose the methods of analysis. In particular, it is desirable to use fast, modern and, of course, highly accurate analysis methods to develop new types of vegetable juice and beverage technology and to determine various physico-chemical parameters of finished products.

Cucumbers, cabbage and carrots were used as the main raw materials for laboratory work for scientific research. The main chemical composition of these raw materials is presented in Table 1.

Table 1

The chemical composition of vegetables selected for the experiment is compared to 100g

Type of vegetable	Oils g	Proteins g	Carbohydrates g	Water g	Ash g	A common shaker g	Dietary fiber g
Cucumber	0.11	0.65	3.63	95.23	0.38	1.7	0.3
Carrot	0.1	1.3	6.9	88	0.2	1.5	2.4
Cabbage	0.2	1.8	4.7	90	0.12	1.42	2

Results. The results obtained by us were first conducted in Namangan region processing enterprises, including "Namangan Sharbat", "Yangikurgan Agro Invest", "Chust Agromir" during the season and the types and sizes of juices produced in Namangan region. Juice samples were taken from studied industries (carrots, cucumbers and cabbage) with the help of enzymes, and the macronutrients and micronutrients contained in them were determined in the scientific laboratory of the Department of Food Technology. For laboratory research, we observed the rate of juice release and the state of cell coagulation in the form of Pectomaserin , Pectinex Ultra SP-L , Pectomaserin G10X, Fructozyme M type enzymes of the vegetables listed in Table 1.

Table 2

Enzyme activity, %

Raw materials	Name of enzymes			
	Pectomaserin	Pectinex Ultra SP-L	Pectomase rin G10X	Fructozyme M
Cucumber juice	5	3-7	5-10	from 11 high
Carrot juice	7	5-10	7-13	from 14 high
Cabbage juice	4	6 - 9	9-12	from 13 high

Protopectinase contained in enzyme preparations breaks down protopectin in plant tissues. As a result, the cells are separated from each other, the tissues become soft. In addition, protopectin, which is a part of cell shells, also breaks down and reduces their mechanical strength. The strength of the protoplasmic membrane also decreases.

Under the action of polygalacturonase, pectin is broken down and juice viscosity decreases.

It increased 10-15 times when using Fructozyme M and Pectomaserin G10X, and only 7 times when using Pectinex Ultra SP-L. At the end of exposures with FP Fructozyme M and Pectomaserin, viscosity

increased 4-6 times, and others with Pectinex Ultra SP-L.

As can be seen from Table 2, the enzyme activity of sample 1 was from 8 to -13, and the activity of the second sample was from 11 to -14.

Charges of juice colloids are neutralized. In water suspensions, bentonite forms a hydrophilic colloidal solution, the charge of the solution changes due to the negative charge of its particles.

Discussion. Thus, the characteristics of the effect of Pectinex Ultra SP-L put it in an intermediate position between preparations intended for tissue maceration - Fructozyme M and Pectomaserin G 10X, and Fructozyme R, intended for increasing the yield of juice. As a result, we can observe the changes in the chemical composition of cucumber and carrot juices in Tables 3-4 .

Table 3

Chemical composition of fermented cucumber juice

Components in cucumber juice 100 grams	Calories, kcal: 14 quantity	In addition, components
Proteins g	0.8	beta-carotene, choline, vitamins A, B1, B2 , B5 , B6 , B9, B12 , C, E, K, H and PP, as well as potassium, calcium, magnesium , zinc, selenium, copper and manganese, iron, chlorine and sulfur, iodine, chromium, fluorine, molybdenum, boron and vanadium, tin and titanium, silicon, cobalt, nickel and aluminum, phosphorus and sodium.
Fats, g:	0.1	
Carbohydrates, g	2.5	

Table 4

Chemical composition of fermented carrot juice

Components of carrot juice 100 grams	Calories, kcal: 56 quantity	In addition, components
Proteins g	1.1 g	A 39% , b-vitamins 42% , IN 1 - 0.7% , B2 - 1.1% , Choline - B5 , B6 , B9 , B12 , C - 3.3% , D , E - 2% , H , vit. K , PP - 1.5% , Potassium - 5.2% , Ca - 1.9% , Si , Mg - 1.8% , Na - 2% , P - 3.3% , Cl , Fe - 3, 3% ,
Fats, g:	0.1	
Carbohydrates, g	12.6 g	
Dietary fiber	1	
Water	85	

Development of recipes and technologies of obtained new types of vegetable drinks

In accordance with the modern principles of creating functional food products and the information obtained in the research process, the production of fruit and vegetable juices based on cucumber juice includes the following operations: reception and preparation of raw materials, preparation of semi-finished products and materials, mixing , packaging, sterilization or aseptic. Packaging in tetra-brick-aseptic.

Preparation of raw materials

Carrots are sorted, washed in A9-KLAL and A9-KM-2 drum washing machines installed in series, checked with cutting tips, rinsed, cleaned. Peeling of carrots is carried out by the steam-thermal method - in a device of the type A9-KChYA at a steam pressure of 0.35-0.40 MPa, and then by cleaning the skin in an A9-KM-2 drum washing machine or another type. Baking time and temperature are set at each plant based on the characteristics of the heat device, steam pressure, carrot type and size, as well as other factors specific to the plant, so the cake will soften a little. possible resulting in pulp. After burning, the temperature inside the carrot should not be lower than 80C. In this mode, carrots are additionally bleached before fermentation.

Cucumbers are sorted, washed, checked and washed. The stalks are removed, cut into pieces 10-20 mm thick, cleaned of seeds and inner film, re-examined, cleaned, rinsed. Cucumber segments are cut into pieces 0.2x0.3 mm thick in an A9-KIS type grinder and fed for enzymatic processing, as can be seen in the above scheme

TECHNOLOGICAL SCHEME OF PROCESSING PRIMARY CUCUMBER JUICE

Cucumber
Primary wash
Inspection
Secondary wash
10-30 mm cutting
It is crushed into pieces of 0.2x0.3 mm thickness in the A9-KIS type grinder
Enzyme treatment
Pressing
Enzyme treatment
Pasteurization
Ultrafiltration
Extraction of juice
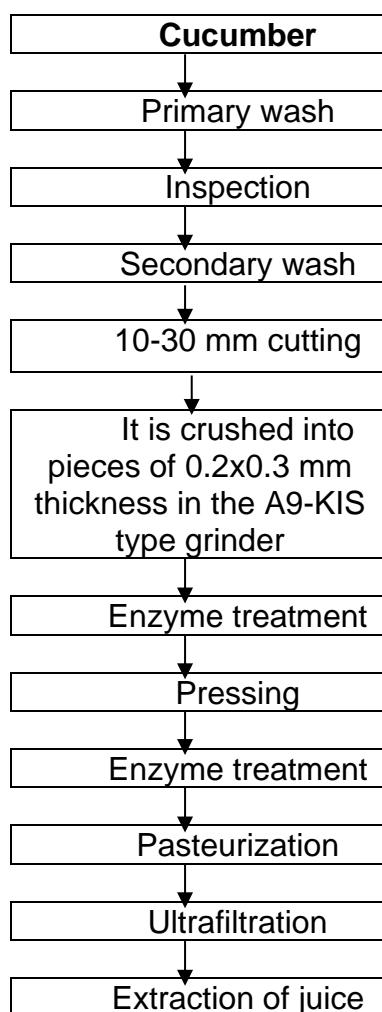
As for the economic efficiency of the obtained new types of cucumber juices, juice from vegetables is being produced in one enterprise.

We prepared the economic calculation books for the development of technology of new types of vegetable juices and beverages as follows .

Table 5

1 ton the price of raw materials for the production of cucumber juice

No	Cucumber juice	The price of raw materials, soum	1 ton of cucumber juice , raw material , kg/l	1 ton of cucumber juice (1000 kg)
1	Cucumber	1000	1 200	1,200,000
2	fermets	24,000	10	240,000
3	Common components that enrich the composition	8 400	25	210,000
4	H_2O	15	1 500	22,500
	Total			**1,672,500**

Based on the given data, we calculate the economic efficiency:

1. Price of raw materials.

For 1 kg of cucumbers: 1,200 soums; For 1 *kg* of enzyme (M) : 24 000 soums; General components enriching the composition of 1 *l* : 8 400 soums and 1 *l* For H_2O: 15 soums were set

2. Total consumption of raw materials: $S_{(b+f+tbk+water)} = G_b \cdot N_b + G_f \cdot N_f + G_{tbk} \cdot N_{tbk} + G_{water} \cdot N_{water} = 1200 \cdot 1000 + 10 \cdot 24,000 + 25 \cdot 8400 + 1500 \cdot 15 = 1,672,500$ soums.

Table 6

The total cost of production of 1 ton of cucumber juice

No	Naming	Price, soum
1	Workers' wages	160 000
2	Single social contribution 15%	24 000
3	Raw material price	1,672,500
4	Additional costs	125 000
5	Unforeseen expenses	50,000
6	Profit 10%	1 40 000
Total		**2 171 500**
7	VAT 15%	325 725
General		**2 497 225**

All costs for the production of cucumber juice presented in Table 6 were calculated to be 2,497,225 soums for 1 ton of finished product in the market economy of production and finished product.

Conclusion. The feasibility of using enzymatic methods to obtain juices and drinks with high nutritional value from cucumber, carrot and white cabbage was determined, theoretically based and experimentally confirmed. Enzymatic maceration of vegetables increases the yield of juice with pulp, enriches it with soluble pectin, preserves vitamin C and p-carotene. A comparative analysis of the effectiveness of various enzyme preparations with a maceration effect was carried out, as a result: ways of their rational use were determined: Pectomaserin G10X and Fructozyme M - for obtaining purees and juices with a stable pulp, Pectinex Ultra SP-L - for small to better separate the juice from the crushed pulp; improved the classification of

macerating preparations. It was calculated that 1 ton of finished product is worth 2,497,225 soums in the market economy of production and finished products.

References

1. "O'zbekiston Respublikasini yanada rivojlantirish bo'yicha harakatlar strategiyasi to'risida"gi O'zbekiston Respublikasi Prezidentining 2017 yil 7 fevraldagi PF-4947-sonli Farmoni.

2. Балашов Н.Н., Овошеводство. Т., 1982, Рубсов М. И., Овошеводство, 3 изд. М, 1985.

3. Rafiqjon Hakimov.<ref>[[O'zME]]. Birinchi jild. Toshkent, 2000-yil</ref>

4. Вокарчук А.Т. "Технология переработкивинограда". М.: "Агропромиздат", 1990.

5. Jo'raev R, Islomov X. «Meva va sabzavotlar–sabzavotlarni saqlash va dastlabki ishlov berish texnologiyasi». (ma'ruza matnlari) Toshkent, 2000. 16-17 b.

6. Komolxon ogli V. Z. et al. Olmani saqlash jarayonlarining nazariy asoslari //Journal of new century innovations. – 2023. – Т. 23. – №. 2. – С. 60-65.6.

7. Шарипов С. Я., Воккосов З. К. У. Способы хранения поздних сортов яблок, выращенных в климатических условиях Наманганской области //Universum: технические науки. – 2021. – №. 12-4 (93). – С. 29-33.

8. Sharipov S. Y., Azizov A. S., Vakkasov Z. K. Storage of apples in different methods in the valley region of Uzbekistan //IOP Conference Series: Earth and Environmental Science. – IOP Publishing, 2022. – Т. 1068. – №. 1. – С. 012029.

9. Воккосов З. К. У. Получение органоминеральных удобрений на основе местных агроруд, минеральных удобрений, навоза крупного рогатого скота и растворов азотфиксирующих микроорганизмов //Universum: технические науки. – 2022. – №. 6-4 (99). – С. 44-48.

10. Zukhriddin V., Murodillaevich K. K., Elbekovich S. B. Obtaing Organomineral Fertilizers on Base of Local Raw Materials and Nitrogen-fixing Microorganisms //Chemical Science International Journal. – 2022. – Т. 31. – №. 4. – С. 44-53.

UDK 537.322.15

ANALYSIS OF THE CURRENT STATUS OF THERMOELECTRIC MATERIALS AND TECHNOLOGY FOR OBTAINING AND MANUFACTURING HALF-ELEMENTS

LATIPOVA MUXAYYO

Senior teacher of Ferghana polytechnic institute
E-mail: muhayyo_0889@mail.ru, Phone: (+99890)2913265

Abstract:

Objective. This article discusses in detail the materials that are of interest in the thermoelectric ratio. The most common members of the $A_2^V B_3^{VI}$ group in the periodic table of Mendeleev. The analysis of the current state of triple compound thermoelectric materials, which are the best materials for thermoelectric generators, as well as the methods and technology of production, the requirements for the technology of obtaining these materials, is carried out.

Methods. Experimental studies were carried out to determine the optimal concentration of current carriers of the required sign, by the method of formation of a non-stoichiometric chemical composition, or by the method of introducing additional dopants.

Results. To obtain a thermoelectric generator with high values of efficiency, as our studies show, the method of fusion under pressure of an inert gas [6-10] is the most effective, which differs in that melting is carried out in a crucible with a shutter. At the same time, the issue of container reuse is being addressed. For the manufacture of half-elements, cutting of solids plays an important role, which affects the energy parameters and efficiency.

Conclusion. The best and most effective way to obtain substances for the legs of a thermoelement is the method of fusion of the charge under the pressure of an inert gas. Thermoelectric semiconductor compounds obtained by this method have high values of thermoelectric figure of merit Z, reaching up to $3.0 \cdot 10^{-3}$ deg^{-1}, which makes it possible to create thermopiles with the best efficiency. The use of an electric spark cutting machine makes it possible to obtain thermopiles with minimal defects and the best quality.

Keywords: thermoelectric material, synthesis, doping, inert gas pressurization technology, half-elements, oxygen cutting, etching

Introduction. The most widely used as low-temperature thermoelectric materials are solid solutions of chemical compounds of the $A_2^V B_3^{VI}$ type from the elements of the fifth and sixth groups of the periodic system of D.I.Mendeleev. Let us agree to call the temperature interval 100-600 K. The natural boundaries of this interval are determined by the possibilities of using a class of substances whose initial components are bismuth, antimony, selenium and tellurium.

The operating conditions of thermoelectric materials in this temperature range are generally favorable. The absolute temperatures are relatively low, which significantly reduces the negative impact of such processes as oxidation, diffusion in the near-contact layers, volatilization of impurities and the main substance, etc.

Bismuth tellurium (Bi_2Te_3), selenium bismuth (Bi_2Se_3) and antimony tellurium (Sb_2Te_3) are of particular interest in thermoelectricity, since they are all used as initial components for creating efficient thermoelectric materials [1-4]. They are not used directly in their pure form, although they have rather high thermoelectric properties, especially when alloyed [4].

An analysis of the current state of thermoelectric materials shows that the best materials for thermoelectric generators are compounds obtained from semiconductor substances, which contain two or three components. Such semiconductors, especially the ternary compound, have a high thermoelectric

figure of merit [4;5]. Obtaining chemical compounds and substances of a certain composition is the main task of synthesis. This is done using a variety of semiconductor technology techniques.

Synthesis is, as you know, obtaining complex structures and compounds from elementary and simple chemical compounds.

Methods. Various impurities have a very great influence on the thermoelectric properties of synthesized materials. Depending on the amount and type of impurities, the formation of various parasitic donor and acceptor levels and a non-optimal concentration of current carriers is possible. Therefore, to obtain a material with the same sign and the required concentration of current carriers, the components of the material should be cleaned before and after synthesis. A positive result of cleaning is a decrease in the degree of concentration of foreign impurities by one order of magnitude compared with the concentration of the main current carriers.

The greatest requirements are imposed on low-alloyed thermoelectric materials with a current carrier concentration of the order of $\sim 10^{18}$ cm^{-3}.

The optimal concentration of current carriers of the required sign can be obtained by the formation of a non-stoichiometric chemical composition, or by the introduction of additional dopants.

In [6] a method is proposed for using nomograms to determine the optimal concentration of the dopant depending on the thermoelectric properties of the base. A number of batches of initial raw materials give bases, the thermoelectric properties of which do not fit within the limits of the nomogram [6]. In this case, it is not possible to obtain an alloyed material with the required properties only by changing the concentration of the introduced dopant.

It is known that some ratios of the feedstock give bases, the thermoelectric properties of which do not make it possible to obtain an alloyed material with optimal properties. Therefore, in order to correct the properties of the base Bi_2Te_3 and Bi_2Se_3, the parameters of materials obtained from different batches of raw materials were investigated. As a method for correcting the properties of the base, we used the introduction of superstoichiometric amounts of chalcogens into the charge. Tellurium and selenium were used as superstoichiometric chalcogens introduced into the charge.

According to the results of the experiments, for the n-type branches Bi_2Te_3-Bi_2Se_3, with the addition of 0.24 mol.% Te to the composition, an alloyed base was obtained with optimal values of its thermoelectric properties σ = 585 Ohm^{-1}·cm^{-1}, α = 204 µV/deg., in figure 1. The optimal concentration of selenium added to the components was 0.12 mol.%, their thermoelectric properties σ= 580÷600 Ohm^{-1}·cm^{-1}, α= 204÷194 µV/deg. (Fig. 2) [5;7;10].
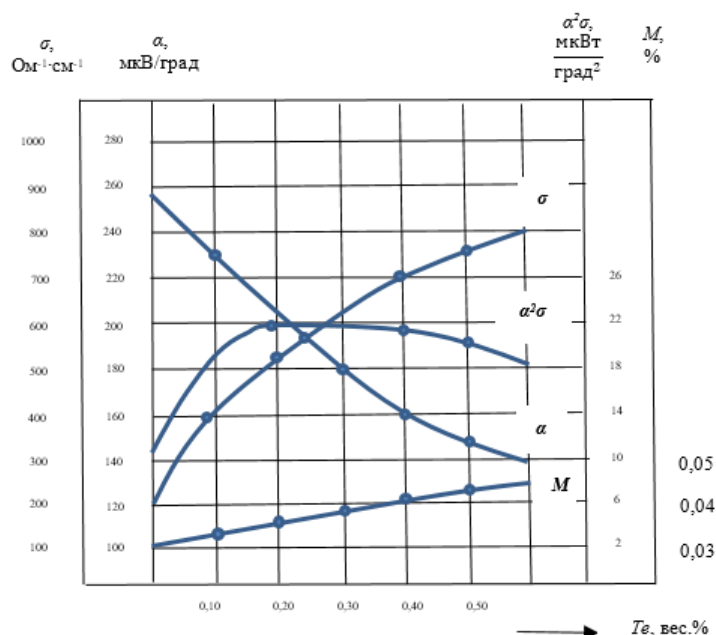
Fig. 1. Dependence of the indices σ, α, α²σ, and M on the Te concentration [5;7;10]
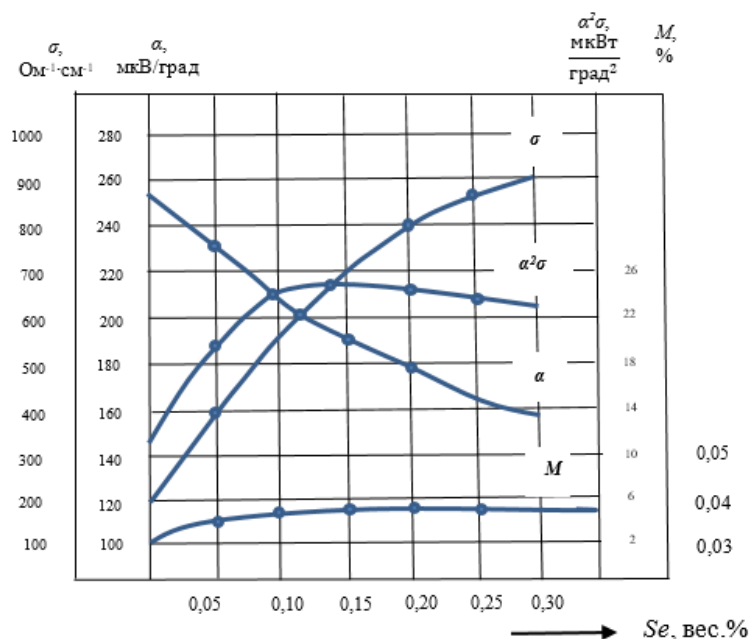
Fig.2. Dependence of the indices σ, α, α²σ and M on the concentration Se [5;7;10]

The last stage is the manufacture of thermoelement legs. However, this stage sets the task of obtaining a thermoelectric material with strong uniform and thermoelectric properties. After that, the materials are subjected to machining and polishing.

Discussion. It is known that it is not always possible to directly use purified, synthesized and alloyed thermoelectric material for the manufacture of thermoelement legs. Formed thermal cracks, porosity and other defects do not allow obtaining thermoelement legs of the appropriate size by mechanical processing of the material. In such cases, the physical and mechanical characteristics do not meet the requirements. In this regard,

68

there is a need to obtain monolithic and defect-free samples. They should be close in shape to the shapes of the thermoelement legs, the required design, and should be subject to minimal mechanical processing.

Such a technological process is carried out by the developed methods for the manufacture of FC branches:

- method of powder metallurgy;
- metallurgical methods;
- method for obtaining single-crystal samples.

The most common methods among powder metallurgy methods are the cold pressing method followed by heat treatment and the hot pressing method. Among the metal methods, the most common is the method of melting, subject to the conditions of directional crystallization. The third method, the method of obtaining single-crystal samples, is the most difficult. However, they are successfully used to obtain thermoelectric materials with the best thermoelectric properties compared to other existing ones. These methods include the Czochralski, Bridgman and various types of zone melting.

Results. To obtain a thermoelectric generator with high efficiency values, as our studies show, the method of fusion under pressure of an inert gas [8-12] is the most effective, which differs in that melting is carried out in a crucible with a shutter. At the same time, the issue of container reuse is being addressed. The fact is that after melting, the material, after light tapping, is easily removed from the overturned crucible without violating its integrity and the integrity of the "float". In this way, a large amount of expensive quartz can be saved.

Upon reaching the required temperature, an exposure is made during which the alloy is fused and homogenized. After holding the alloy at the specified temperature, the furnace is turned off, and the sleeve is cooled and the ingot is unloaded after the furnace has completely cooled to room temperature.

For the manufacture of half-elements, cutting of solids plays an important role, which affects the energy parameters and efficiency [12-20]. The existing various solid cutting methods such as oxy-fuel cutting, shielding gas cutting, precision cutting, micro-beam oxy-fuel cutting, flame gouging, iron powder feeding cutting, arc cutting, high-speed plasma cutting, and even laser cutting, for one reason or another, are not quite suitable for cutting semiconductor thermoelectric materials.

Even if some of the methods listed above are used, then one can see the roughness of the performed process, or, a change in the chemical composition of substances, the insufficient accuracy of the geometric dimensions of the half-elements. Our experience and analysis shows that the best option for using installations for cutting thermoelectric materials of a triple compound fused under inert gas pressure is the use of electric spark cutting installations.

At the same time, the substance from which the half-elements are cut is securely and firmly fixed to the moving parts of the installation. For this, special supports are used to fasten the material. Fastening is carried out by soldering. Soldering the substance on the stand can be done with bismuth tin solder (58 Bi, 42 Sn). This solder has a melting point of 136°C. The authors of [14] propose the use of BiSnSb solder with a melting temperature of 140°C. The soldering material we recommend is very suitable for heat sensitive parts in the semiconductor industry.

After cutting, the half-elements are etched. To ensure high-quality etching of semiconductor materials, their surface is thoroughly cleaned. This process is important because contaminated areas are not susceptible to etching. To prepare the surface for etching, you can use degreaser bottles, medium-hard industrial

brushes (natural bristles), and spare degreaser bottles.

If the etching operation is carried out over a small number of half-elements of thermoelements (FCs), then it is sufficient to use a fluoroplastic cup with an etching mixture (of course, the mixture must be specially prepared!). In the case of serial production, pickling devices with and without heating should be used. Water is known to be used to terminate the etching reaction. Therefore, for this purpose, the use of washing machines with a manual or mechanical feed system is recommended. Etched and washed plates or crystals are laid out in a clean vessel.

Conclusion. The best and most effective way to obtain substances for the legs of a thermoelement is the method of fusion of the charge under the pressure of an inert gas. Thermoelectric semiconductor compounds obtained by this method have high values of thermoelectric figure of merit Z, reaching up to $3.0 \cdot 10^{-3}$ deg^{-1}, which makes it possible to create thermopiles with the best efficiency. The use of an electric spark cutting machine makes it possible to obtain thermopiles with minimal defects and the best quality.

References

1. Воронин А.Н., Гринберг В.З., Савельева А.Н. в сборнике Термоэлектрические свойстве полупроводников. / Изд-во АН СССР. 1963. с.109-120.

2. Гольцман Б.М., Кудинов В.А., Смирнов И.А. / Полупроводниковые термоэлектрические материалы на основе Bi_2Te_3. М.: Наука,1972. с.302-309.

3. Иоффе А.Ф. Полупроводниковые термоэлементы. / М.-Л.: Изд-во АН СССР, 1960.с.132-171.

4. Охотин А.С., Ефремов А.А., Охотин В.С., Пушкарский А.С. Термоэлектрические генераторы. М.: Атомиздат, 1976.-320с.

5. Латипова, М. И., Хомиджонов, З. М., Усмонов, Я., & Набиев, М. Б. (2020). Исследование термоэлектрических полупроводниковых материалов для высокоэффективных термоэлектрогенераторов. *Научно-технический журнал Наманганского инженерно-технологического института*, 5(1), 125-131.

6. Nabiev Makhmud Bozorovich, Khomidzhonov Zukhriddin Mayrufjon Ugli, Latipova Mukhayyo Ibragimjanovna, Abdullaev Abduvokhid Abdugappar Ugli, Ergashev Komiljon Ravshan Ugli, Rakhimov Mirkamol Farkhodjon Ugli Obtaining and researching of thermoelectric semiconductor materials for high-efficienting thermoelectric generators with an increased efficiency coefficient//Проблемы Науки. 2019. №12-2 (145). URL: https://cyberleninka.ru/article/n/obtaining-and-researching-of-thermoelectric-semiconductor-materials-for-high-efficienting-thermoelectric-generators-with-an-increased

7. Xu X., Li H., Zhang Q., Hu H., Zhao Z., Li J., Li J., Qiao Yu, Gogotsi Yu Self-Sensing, Ultralight, and Conductive 3D Graphene. // Iron Oxide Aerogel Elastomer Deformable in a Magnetic Field. ACS Nano.2015. 9(4): Pp. 3969-3977.

8. Усмонов Я., Способ получения полупроводниковых материалов для термопреобразователей /Усмонов Я., Набиев М., Ахмедов Т., Набиева Н., Юлдашева И.И.//Актуальные вопросы высшего профессионального образования, сборник научных трудов Международной научно-методической конференции, Уфа, Издательство УГНТУ, 2017. с. 108-112.

9. Латипова Мухайё Ибрагимжановна, Усмонов Якуб, Набиев Махмуд Базарович, Технология получения низкотемпературных термоэлектрических

материалов на основе bitese-bisbte под давлением инертного газа//Universum: технические науки. 2020. №10-3 (79).

10. Латипова М.И. Исследование эффективного метода сплавления с последующим легированием низкотемпературных термоэлектрических материалов на основе Bi_2Te_3-Bi_2Se_3, Scientific-technical journal (STJ FerPI, ФарПИ ИТЖ, НТЖ ФерПИ, 2022, спец выпуск №2, стр.188-191.

11. Latipova M.I. (2022). Termoelektrik oʻzgartirgichlar uchun vismut telluridi asosidagi yarimoʻtkazgichli materiallarni olish texnologiyasi. Involta Scientific Journal, 1(6), 129–134. Retrieved from https://involta.uz/index.php/iv/article/view/171

12. Касимахунова А.М., Усмонов Я., Латипова М.И., Bi_2Te_3 асосидаги термоэлектрик материалларни олиш технологияси, Монография, ISBN:978-9943-8501-9-4, Классик нашриёти, 2022.

13. Латипова М.И., Касимахунова А.М., Набиев М.Б., Исследование экстремалных режимов работы термоэлементов на основе термоелектрических материалов BiTeSe-BiSbTe, НТЖ ФерПИ, 2022, Т.26, спес. №1, с.156-160

14. М.Б.Набиев, О.Сиддиков, М.И.Латипова, Эксплутационные характеристики экстремальных режимов работы полупроводниковых термоэлементов с использованием импульсов тока специальной формы, «Глобальная наука и инновация 2020: Центральная Азия» № 5(10). Август 2020, серия «Технические науки», стр. 212-215.

15. Щенников В.В., Коробейников И.В., Морозова Н.В. Влияние физических и «геометрических» факторов на свойства термоэлектрических материалов. // Термоэлектричество. 2013. № 6. с. 41–52.

16. Касимахунова А.М., Усмонов Я., Латипова М.И., Bi_2Te_3 асосидаги термоэлектрик материалларни олиш технологияси, Монография, ISBN:978-9943-8501-9-4, Классик нашриёти, 2022.

17. Набиев М.Б., Усмонов Я., Гайназарова К.И., Тожиматов К., Холмирзаев Ж. Нестационарное термоэлектрические охлаждение (НТЭО) с учетом выделения тепла джоуля в коммутационном слое. // Анталия 2016. Илмий тўплам. Т.3. №1792. С.302-307.

18. A. M. Kasimakhunova, S. I. Zokirov, M. A. Norbutaev. "Development and Study of a New Model of Photothermogenerator of a Selective Radiation with a Removable Slit." IJARSET. Vol. 6, Issue 4, April 2019, India.

19. A.M.Kasimakhunova, S.I.Zokirov, M.A.Norbutaev. "Development and research of a new model of Photothermogenerator of selective radiation". First international congress of the Turkic world on health and natural science. 22-23 april, 2019. Kyrgyzstan.

20. A. M. Kasimaxunova, Maxsudjon Norbutaev, Madinaxon Baratova Thermoelectric generator for rural conditions // Scientific progress. 2021. №6. URL: https://cyberleninka.ru/article/n/thermoelectric-generator-for-rural-conditions

UD541.183

PHYSICO-CHEMICAL PROPERTIES OF ACTIVATED ADSORBENTS BASED ON LOGAN BENTONITE

OCHILOV GOLIBJON

Professor of Kokan state pedagogical Institute
E-mail: golibjon.ochilov@mail.ru, phone: (+99891) 683-69-80

BOYMATOV ISMOILJON

Associate professor of Kokan state pedagogical Institute
phone: (+99891) 683-69-80

GANIYEVA NAZOKAT

Doctoral student of Namangan Inistitute of Enginering and Technology
e-mail: muradullayevanazokat@gmail.com, phone: (+99897) 574-16-17

Abstract:

Objective. The article clarifies the physicochemical properties of adsorbents activated from Logon bentonite under various thermal and chemical conditions. It has been established that the desorption lines in the LBK and LBI intersect with the adsorption lines at a relative pressure R/Rs = 0.1–0.2, forming an adsorption hysteresis surface.

Results. Nowadays, modified bentonites, especially organobentonites (concrete), are increasingly used in various sectors of the economy [3]. In particular, in the treatment of industrial waste water by adding bentonite to polymeric substances obtained on the basis of various industrial wastes, as a stabilizer in increasing the thermal stability of silicone rubbers, in improving the rheological properties of drilling fluids, as a binding and hardening additive for coal briquettes.

Methods. The adsorption of non-polar benzene vapors on the obtained modified bentonites was studied. Samples modified on the basis of logan bentonite (LB) were thermally and chemically treated before being used in adsorption. Adsorbents obtained under such conditions: chemically activated; LBK, LBI and thermal treatment were designated as LB-1, LB-2, LB-3

Conclusions. According to the results of industrial experiments, it was found that these adsorbents can be used as adsorbents in the treatment of organic and inorganic waste substances in the waste water of various industries.

Keywords: bentonite, benzene, adsorbent, absorbate, adsorption, desorption, isothermal monolayer capacity, specific surface.

Introduction. The rapid development of industrial sectors, the use of various technologies in technological processes leads to an increase in the demand for effective adsorbents used in this field. Preparation of such adsorbents on the basis of local raw materials, including Logan bentonite clay, is of particular importance. Considerable scientific research has been conducted in our country to study the properties of mineral adsorbents such as adsorption properties, surface area, nature and strength of active centers [1]. Modified adsorbents based on Navbahor alkaline bentonite and various organic compounds were obtained and their adsorption properties and thermodynamic characteristics of phase state changes in adsorbed substances were studied [2].

Results. Nowadays, modified bentonites, especially organobentonites (concrete), are increasingly used in various sectors of the economy [3]. In particular, in the treatment of industrial waste water by adding bentonite to polymeric substances obtained on the basis of various industrial wastes, as a stabilizer in increasing the thermal stability of silicone rubbers, in improving the rheological properties of drilling fluids, as a binding and hardening additive for coal briquettes. It is used as an

adsorbent that absorbs various microorganisms, in the treatment of water contaminated with heavy metals and oil products, in the retention of dyes from the wastewater of finishing factories, in the production of purified sulfur from technical sulfur, in the production of various antibacterial adsorbents [4]..

Methods. The adsorption of non-polar benzene vapors on the obtained modified bentonites was studied. Samples modified on the basis of logan bentonite (LB) were thermally and chemically treated before being used in adsorption. Adsorbents obtained under such conditions: chemically activated; LBK, LBI and thermal treatment were designated as LB-1, LB-2, LB-3 [5].

The quantitative and qualitative composition of the functional groups in the obtained adsorbents was determined by IR-spectroscopy (Shimadzu IRTracer100, Japan). The high sensitivity of the spectra (60,000:1 signal/noise ratio) leads to the continuous analysis of the amount of impurities in different samples, despite the low intensity of the lines of interest in the spectrum. The IRTracer-100's spectral resolution of 0.25 cm^{-1} provides high resolution for quantification of spectral identification, especially in the case of gaseous compounds. Interferometer performance optimization system together with internal self-diagnosis ensures stable operation of the device. IR-spectra of activated adsorbent in acidic and alkaline environment are presented in Fig. 1.
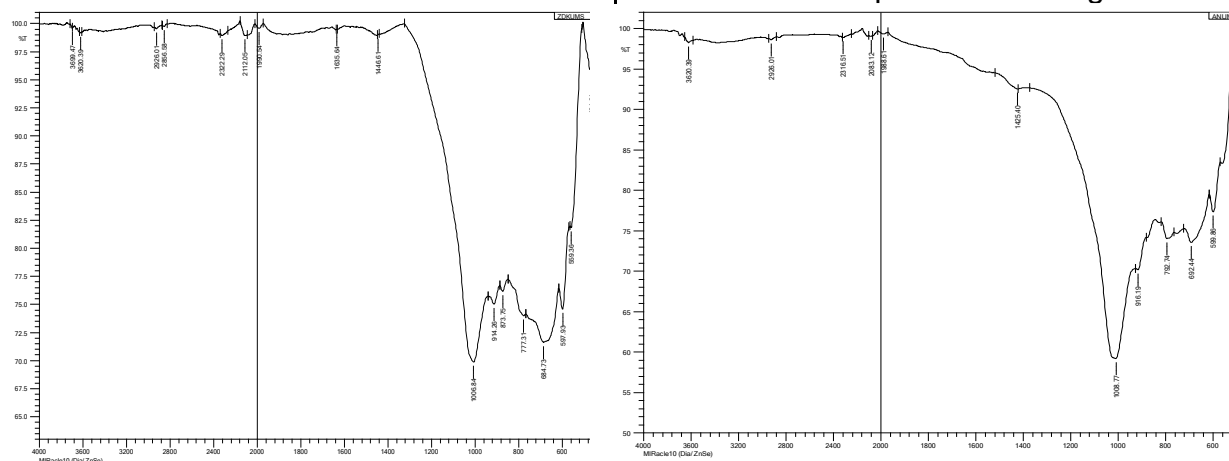
Figure 1. IR-spectra of activated adsorbent in acidic and alkaline media

From the analysis of the literature and the results of IR-spectra of obtained adsorbents, LBI adsorbent contains organo-metal (400-900 sm^{-1}), Al-O-Si or Si-O-Si (914-1007 sm^{-1}), Al=O (1447-1636 sm^{-1}), Al≡Si (2112-2322 sm^{-1}), Si-H (2856-2926 sm^{-1}), -OH (3600±50 sm^{-1}) groups can be seen. LBK adsorbent contains organo-metallic (400-900 sm^{-1}), Si-O-Si (1009 sm^{-1}), Si≡Si (2033-2166 sm^{-1}), -OH (3600± sm^{-1}) functional groups was determined. It is possible to see the high intensity of the peaks characteristic of the orgo-metal bond in these samples. Moreover, in the formation of these adsorbents, we can say that the interaction between metal and silicon in bentonite is

strong. As a result of the modification, the formation of a new group of Si-O-Me atoms as a result of the interaction of the Si-O-group of atoms in bentonite with metal atoms. The high intensity of the IR spectrum peaks at 914-1007 sm^{-1}confirms the conclusions. . As a result of the interaction of acid with oxygenated functional groups on the surface of bentonite, additional pores are formed in the adsorbents, as a result, the size of the pores decreases, that is, the amount of mesopores decreases, and micropores amount increases.

In order to increase the reliability of the above data, X-ray analyzes were taken at the UzRFA Institute of Biorganic

73

Chemistry. The chemical composition of activated adsorbents was analyzed.

Table 1

X-ray image and chemical composition of Log'on bentonite (LB)

Mineral	LB (%)	LBK (%)
SiO_2	10,17	10,17
Feldspar	8,05	7,10
clinoptilolite	5,71	4,51
Muscovite-KAl2(Si3Al) O10(OH,F)2	5,83	8,83
Illite (K,H3O)(Al,Mg,Fe)2(Si,Al)4O10[(OH)2,(H2O)]	10,84	7,84
Diopside-CaMgSi2O6	1,58	1,58
Montmorillonite (Na,Ca)0,3(Al,Mg)2Si4O10(OH)2•n(H2O)	57,82	59,97
Total:	100	100

It can be seen from Table 1 that Log'on bentonite contains SiO2 10.17%, feldspar 8.05%, clinoptilolite 5.71%, muscovite 5.83%, illite 10.84%, diopside 1.58% and mondmorillonite 57.82%, as a result of activation of Log'on bentonite with acid it contains feldspar from 8.05% to 7.1%, clinoptilolite 5.71%, muscovite 5.83%, illite 10.84%, diopside 1.58% and mondmorillonite 57.82%. From this, it can be concluded that when Log'on bentonite is activated with acid, the amount of montmorillonite in its content increases by 2.15%. It is known from the literature that an increase in the amount of montmorillonite in bentonite has a positive effect on its sorption properties.

Benzene adsorption in LBK and LBI (activated in acid and alkaline conditions) adsorbents is very low compared to LB-1, LB-2, LB-3, adsorption in the initial states of adsorption. This is related to the electronic nature and interactions of cations (Na+ and [Al13O(OH)24(H2O)12]7+) and benzene molecules located between the adsorbent layers. It can be seen from the adsorption isotherms that at high specific relative pressures (R/Rs □ 0.3) the amount of adsorption in LBK and LBI increases sharply (Fig. 2).
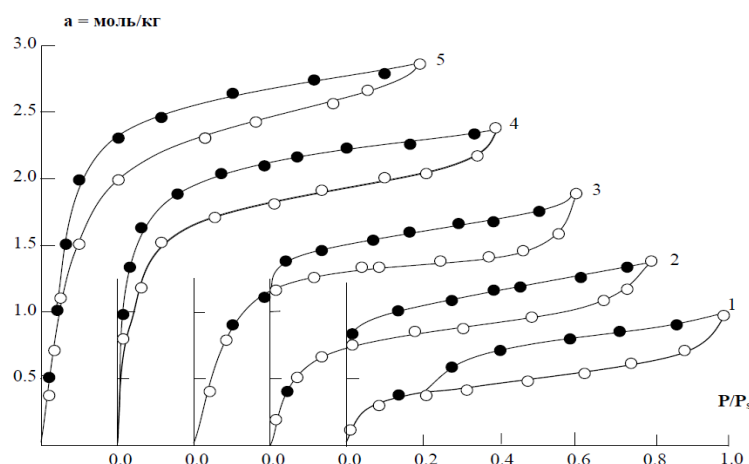

Figure 2. Adsorption isotherms of benzene vapors on activated bentonites LB-1 (1), LB-2 (2), LB-3 (3), LBI (4), LBK (5)

In most cases, adsorption processes in chemically activated bentonites proceed with capillary condensation, in such cases adsorption hysteresis is observed. The desorption lines in LB-1, LB-2, and LB-3 intersect with the adsorption lines at

relative pressure R/Rs = 0.2, forming an adsorption hysteresis surface. Formation of adsorption hysteresis surfaces in adsorbents occurs due to adsorption of adsorbate molecules in different pores formed in mineral layers.

The relative relative pressure (P/Ps) of the hysteresis loops in the adsorption isotherm in LBI and LBK approaches to zero value due to the interaction of benzene molecules with the central atom in the adsorbent.

The surface area (S) of the adsorbents was determined from the structural adsorption parameters using the equation of the Brunauer, Emmet, Teller (BET) theory. If the ordinate is P/Ps/a(1 - P/Ps) and the values of P/Ps are placed on the abscissa axis, straight line coordinates are obtained.

Based on the isotherms of benzene vapor adsorption on modified adsorbents, the monolayer capacity am, saturation volume Vs (or adsorption as), and their relative surfaces S were calculated from the important parameters of adsorbents (see Table 2).

Table 2

Structure and sorption indicators of benzene vapor adsorption of modified bentonites thermally treated at different temperatures

Adsorbents	Single floor capacity, a_m, mol/kg	Comparison surface, $S \cdot 10^{-3}$, m^2/kg	Saturation adsorption a_s, mol/kg
LB-1	0,19	45	1,14
LB-2	0,53	149	1,40
LB-3	0,68	164	1,87
LBI	0,76	175	2,47
LBK	0,83	198	3,10

Specific surface area (S) for all adsorbents from the table: 45 103 m^2/kg for LB-1, 149 103 m^2/kg for LB-2, 164 103 m^2/kg for LB-3, 175 103 m^2/kg for LBI and 200 103 for LBI m^2/kg and saturation adsorption (as): 1.14 mol/kg in LB-1, 1.40 mol/kg in LB-2, 1.87 mol/kg in LB-3, 2.47 mol/kg in LBI, 3.10 in LBK mol/kg was found to be equal. So, as a result of chemical activation, comparing the adsorption of benzene vapor compared to Logon bentonite (LB-1), it can be seen that it leads to an increase in adsorption to 1.14-2.47 in LBI and 1.14-3.10 in LBK.

When activated in such conditions, due to the release of physically adsorbed water molecules and additional salts in the samples, modified clays are associated with the formation of additional spaces (porosity) between the layers.

Thus, in the work, the adsorption of benzene vapors on clay adsorbents activated by thermal and chemical methods was studied under different conditions. According to the results of benzene vapor adsorption of adsorbents, the adsorption capacity of activated adsorbents was ranked according to the saturation adsorption volume (Vs) in the following order:

LBK > LBI > LB-3 > LB-2 > LB-1

The arrangement of activated adsorbents in terms of their ability to absorb benzene molecules in this order is the removal of additives contained in bentonite as a result of chemical activation, on the other hand, the specificity of the interaction of non-polar benzene molecules with activated adsorbents, that is, hydrophilic and lyophilic adsorbents is related to the change of nature. In LBK, the

amount of benzene vapor adsorption is higher than other adsorbents, the adsorbent is cleaned from the substances released in acidic conditions between the adsorbent layers, and the adsorbent's lyophilicity and porosity increase.

Wastewater treatment using modified adsorbents.

A large amount of water is used in the field of oil production, and a large part of this water is being cleaned using various methods in open water reservoirs. A large amount of acidic and alkaline water is produced during the refining of oils and fats in oil industry enterprises. Such wastewater has an unpleasant smell.

In most cases, soda ash is used as a reagent to neutralize acidic waters, but its high cost makes it less practical and less effective.

Therefore, it is an urgent task to replace expensive imported reactants with adsorbents produced on the basis of cheaper local raw materials. For this purpose, cheap wastewater obtained on the basis of Logon bentonite was used in the treatment of acidic wastewater with a pH of 1.2-1.7 with adsorbents capable of comprehensive treatment.

Waste water of oil-oil production plants is contaminated with organic compounds in the form of fatty products (vegetable oils, animal fats, fatty acids, phosphatides, soaps, etc.) in emulsion state. To date, "Yog-gar" JSC wastewater is cleaned by collecting oily substances in a clarifier, then acidic water is neutralized with sodium carbonate and discharged through sewage pipes. Oily substances in wastewater are not cleaned by adsorption method. In laboratory conditions, experimental test works were carried out on industrial waste water purification using adsorbents modified by activation of inorganic and organic substances.

From the results of the experiment, it was found that the pH value of adsorbents obtained by the method of thermal activation: 5.3 in LB-2, 3.1 in LB-3, adsorbents obtained by the method of chemical activation: 4.6 in LBK, 5.4 in LBI. It was found that with the help of adsorbents activated in an alkaline environment, logan bentonite can remove 80% of acid anions, 97% of organic substances, and increase the pH value from 1.7 to 5.2 (Table 2).

Table 2

Results of "Yog-gar" JSC wastewater treatment by adsorption method

Adsorbents	Wastewater indicators, mg/l							
	pH	Na^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	HCO_3^-	OQ^*
Amount of ions in wastewater	1,7	21	92	61,2	640	903	11	520
LBI	5,3	19,81	23,33	44,21	301,22	324,2	2.21	12,21
LBK	3,1	23,02	70,41	54,12	614,31	825,3	8,52	191,2
LB-2	4,6	20,82	22,62	44,34	308,42	343,2	-	16,42
LB-1	4,4	22,12	85,21	56,13	604,41	792,6	3,41	52,63

Conclusions. According to the results of industrial experiments, it was found that these adsorbents can be used as adsorbents in the treatment of organic and inorganic waste substances in the waste water of various industries. The use of these adsorbents as adsorbents in various industries makes it possible to eliminate the demand for adsorbents in our Republic in a certain sense. Firstly, the lack

of adsorption capacity of imported adsorbents is economically effective by saving foreign currency based on the use of local adsorbents instead, and secondly, it is ecologically effective due to the characteristics of industrial wastewater treatment.

References

1. Muminov S.Z., Aripov E.A., Research in the field of thermodynamics and thermochemistry of adsorption on clay minerals. Tashkent Fan 1987.144p

2. Muminov., Khandamov D.A., Rakimov G.B. Equilibrium adsorption of benzene vapor on alkylammonium montmorillonitax // Colloid. legal. - 2015. - Volume 77. - No. 5. - P. 675-680.

3. Tikhomirova E.I., Zamatyrina V.A., Boichenko E.A., Koshelev A.V. Ecological justification for obtaining and using biologically active organobentonites // Fundamental research. - 2013. - No. 4-3. - S. 660-662.

4. Zamatyrina V. A. Method of purification of wastewater from heavy metals and oil products using modified organobentonite: Abstract of the thesis. dis. … cand. Tech. Sciences. - Penza. SGTU, 2015. - 19 p.

5. Nuriddinova F.M. Adsorption of active dyes from the composition of wastewater from cosmetic factories // Uchenyy XXI veka. International scientific journal. – 2016. – No. 2-1. - S. 11-15.

6. G'.M. Ochilov, I.M. Boymatov, K.K. Isakov, N. G'aniyeva, O.K. Ergashev Adsorption of various substances on activated adsorbents based on natural raw materials

UDC 662.997÷621.47

SIMULATION OF HEAT TRANSFER PROCESS IN ABSORBER CHANNELS

NIGMATOV ULUGBEK

Senior Lecturer of Fergana Polytechnic Institute
E-mail: ulugbeknigmatov488@gmail.com, phone: (+99891) 113-59-40

Abstract:

Objective. At present, the issues of systematization of the energy balance, the development of thermal and mathematical models, as well as the generalization of methods and computer programs for calculating photovoltaic thermal modules are relevant.

Methods. The program "Comsol Multiphysics 5.6." was used to simulate the process occurring inside the absorber. To describe the laminar motion of a liquid (water), a non-stationary system based on the Navier-Stokes equation and the [1] heat distribution equation was used.

Results. This article describes a mathematical model of heat transfer in absorber channels developed using the «Comsol Multiphysics 5.6. program». The results are presented for determining the longitudinal flow velocity at various sections of the flow channel, heat distribution over time, as well as the heat distribution isoline and isotherm.

Conclusion. Developed on the basis of the program «Comsol Multiphysics 5.6.» a simulation model of heat transfer from a photovoltaic battery to a heat absorber can be used to calculate heat and power supply systems. The use of a simulation model in the design of a heat and power supply system makes it possible to reduce the consumption of heat and electricity.

Keywords: absorber, flow, temperature, hydrostatic pressure, viscosity coefficient, flow channel.

Introduction. Design of solar power plants, allowing to generate electrical and thermal power on an energetically tangible scale without negative impact on the environment; experimental research and practical application of solar power plants

[2, 3, 4]; research to improve the efficiency of photoelectric conversion; development and improvement of existing structures for air, water heat supply, cooling and heat removal with forced cooling [5, 6, 7]; the widespread use of automated control systems in solar power plants [8, 9] are priority areas for the Central Asian region.

A comprehensive study of heat exchange processes makes it possible to reduce the dimensions of heat exchangers in the manufacturing sector by increasing their efficiency.

Actual problems of the theory of heat transfer at present are issues related to the intensification of convective heat transfer. It should be noted here that the problems associated with heat transfer in laminar flow are not widely considered and studied due to the limited number of research works. As is known, according to the theory of the boundary layer, in the laminar regime, the movement of fluid in the near-wall surface transfers heat more efficiently than in the case of flow turbulence.

Although a number of developed and researched methods of heat transfer intensification are known, they are classified into two main categories.

There are many recommendations of researchers on the issues of heat transfer in pipes with various types of intensifiers, the constructive solution of which depends on changes in loads, physical properties of the medium, and process features.

At present, the issues of systematization of the energy balance, the development of thermal and mathematical models, as well as the generalization of methods and computer programs for calculating photovoltaic thermal modules are relevant.

Methods. The physical picture of the analyzed flow of a liquid (water) thermal agent and the configuration of the computational domain are [1] shown in (Fig. 1, 2). The program "Comsol Multiphysics 5.6." was used to simulate the process occurring inside the absorber.
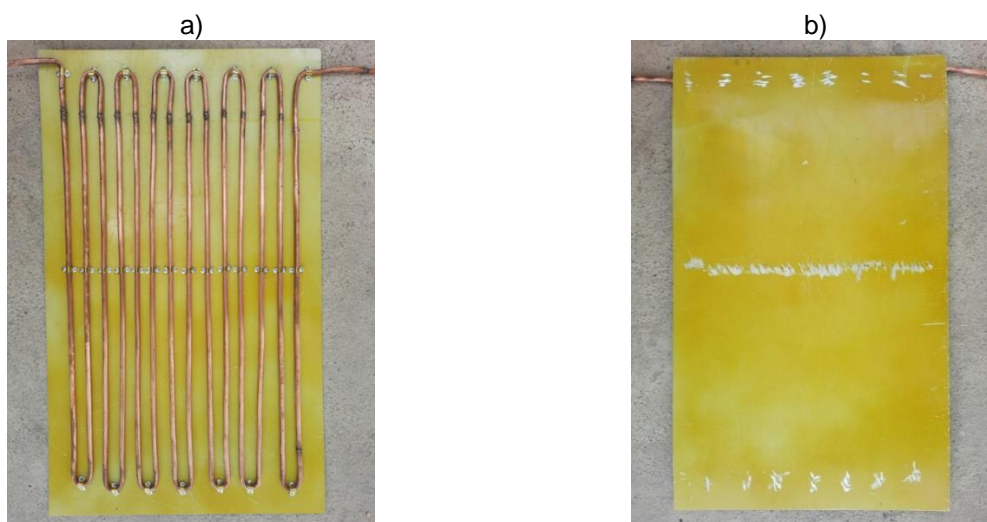

Figure 1. General view of the studied thermal absorber: lower (a) and upper (b) sides
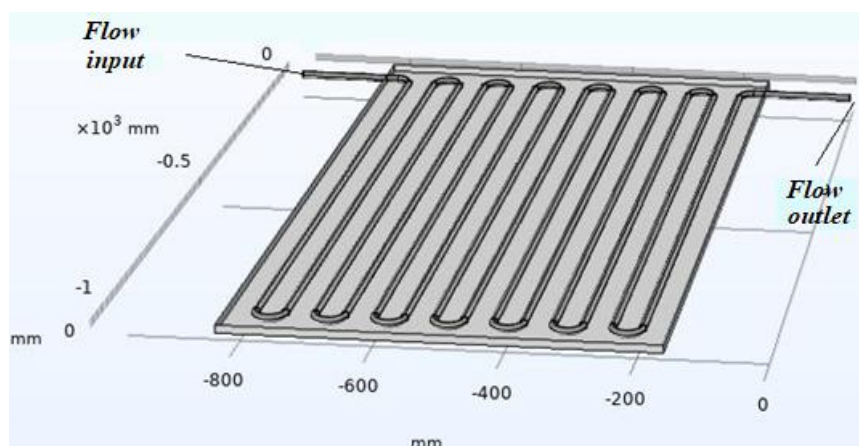
Figure 2. General view of the thermal absorber

To describe the laminar motion of a liquid (water), a non-stationary system based on the Navier-Stokes equation and the [1] heat distribution equation was used. These equations in cylindrical coordinates (z, r, ε) have the following form [10]:

$$
\begin{cases}
\dfrac{\partial r V_z}{\partial z} + \dfrac{\partial r V_r}{\partial r} + \dfrac{\partial V_\varepsilon}{\partial \varepsilon} = 0, \\[2mm]
\rho\left(\dfrac{\partial V_z}{\partial \tau} + V_z \dfrac{\partial V_z}{\partial z} + V_r \dfrac{\partial V_z}{\partial r} + \dfrac{V_\varepsilon}{r}\dfrac{\partial V_z}{\partial \varepsilon}\right) = -\dfrac{\partial p}{\partial x} + \mu\left(\dfrac{\partial^2 V_z}{\partial z^2} + \dfrac{\partial^2 V_z}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 V_z}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial V_z}{\partial r}\right), \\[2mm]
\rho\left(\dfrac{\partial V_r}{\partial \tau} + V_z \dfrac{\partial V_r}{\partial z} + V_r \dfrac{\partial V_r}{\partial r} + V_\varepsilon \dfrac{\partial V_r}{\partial \varepsilon} - \dfrac{V_\varepsilon^2}{r}\right) = -\dfrac{\partial p}{\partial r} + \mu\left(\dfrac{\partial^2 V_r}{\partial z^2} + \dfrac{\partial^2 V_r}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 V_r}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial V_r}{\partial r}\right), \\[2mm]
\rho\left(\dfrac{\partial V_\varepsilon}{\partial \tau} + V_z \dfrac{\partial V_\varepsilon}{\partial z} + V_r \dfrac{\partial V_\varepsilon}{\partial r} + V_\varepsilon \dfrac{\partial V_\varepsilon}{\partial \varepsilon} - \dfrac{V_\varepsilon V_r}{r}\right) = -\dfrac{\partial p}{\partial \varepsilon} + \mu\left(\dfrac{\partial^2 V_\varepsilon}{\partial z^2} + \dfrac{\partial^2 V_\varepsilon}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 V_\varepsilon}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial V_\varepsilon}{\partial r}\right), \\[2mm]
\rho c_p\left(\dfrac{\partial T}{\partial \tau} + V_z \dfrac{\partial T}{\partial z} + V_r \dfrac{\partial T}{\partial r} + \dfrac{V_\varepsilon}{r}\dfrac{\partial T}{\partial \varepsilon}\right) = \dfrac{\partial}{\partial z}\left(\lambda \dfrac{\partial T}{\partial z}\right) + \dfrac{\partial}{r \partial r}\left(r\lambda \dfrac{\partial T}{\partial r}\right) + \dfrac{1}{r}\dfrac{\partial}{\partial \varepsilon}\left(\dfrac{\lambda}{r}\dfrac{\partial T}{\partial \varepsilon}\right).
\end{cases} \quad (1)
$$

In the above equations, V_z, V_r, V_ε are the axial, radial, and tangential components of the flow velocity vector, respectively, and T is the temperature. p is the hydrostatic pressure, μ is the dynamic coefficient of viscosity, c_P is the heat capacity, λ is the thermal conductivity.

When dimensionless values are introduced, the pipe diameter, D, is taken as the length scale, and the average flow rate, U_0 at the pipe inlet, is taken as the velocity scale.

Dimensionless parameters are introduced:

$$
U = \frac{V_z}{U_0}, V = \frac{V_r}{U_0}, W = \frac{V_\varepsilon}{U_0}, \mathrm{Re} = \frac{\rho D U_0}{\mu}, \mathrm{Pr} = \frac{\lambda}{\mu c_p}.
$$

After the introduction of dimensionless quantities, the system equation (1) takes the following form.

$$\begin{cases} \dfrac{\partial rU}{\partial z} + \dfrac{\partial rV}{\partial r} + \dfrac{\partial W}{\partial \varepsilon} = 0, \\[2mm] \dfrac{\partial U}{\partial \tau} + U\dfrac{\partial U}{\partial z} + V\dfrac{\partial U}{\partial r} + \dfrac{W}{r}\dfrac{\partial U}{\partial \varepsilon} = -\dfrac{\partial p}{\rho \partial x} + \dfrac{1}{Re}\left(\dfrac{\partial^2 U}{\partial z^2} + \dfrac{\partial^2 U}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 U}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial U}{\partial r}\right), \\[2mm] \dfrac{\partial V}{\partial \tau} + U\dfrac{\partial V}{\partial z} + V\dfrac{\partial V}{\partial r} + W\dfrac{\partial V}{\partial \varepsilon} - \dfrac{W^2}{r} = -\dfrac{\partial p}{\rho \partial r} + \dfrac{1}{Re}\left(\dfrac{\partial^2 V}{\partial z^2} + \dfrac{\partial^2 V}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 V}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial V}{\partial r}\right), \\[2mm] \dfrac{\partial W}{\partial \tau} + U\dfrac{\partial W}{\partial z} + V\dfrac{\partial W}{\partial r} + W\dfrac{\partial W}{\partial \varepsilon} - \dfrac{WV}{r} = -\dfrac{\partial p}{\rho \partial \varepsilon} + \dfrac{1}{Re}\left(\dfrac{\partial^2 W}{\partial z^2} + \dfrac{\partial^2 W}{\partial r^2} + \dfrac{1}{r^2}\dfrac{\partial^2 W}{\partial \varepsilon^2} + \dfrac{1}{r}\dfrac{\partial W}{\partial r}\right), \\[2mm] \dfrac{\partial T}{\partial \tau} + U\dfrac{\partial T}{\partial z} + V\dfrac{\partial T}{\partial r} + \dfrac{W}{r}\dfrac{\partial T}{\partial \varepsilon} = \dfrac{1}{Re\,Pr}\dfrac{\partial}{\partial z}\left(\dfrac{\partial T}{\partial z}\right) + \dfrac{1}{Re\,Pr}\dfrac{\partial}{r\partial r}\left(r\dfrac{\partial T}{\partial r}\right) + \dfrac{1}{Re\,Pr}\dfrac{1}{r}\dfrac{\partial}{\partial \varepsilon}\left(\dfrac{1}{r}\dfrac{\partial T}{\partial \varepsilon}\right). \end{cases} \quad (2)$$

Obvious no-slip boundary conditions are set on all fixed solid walls $U\big|_{hb}=0$, $V\big|_{hb}=0$ and $W\big|_{hb}=0$, where hb – hard border. At the channel outlet in the section for horizontal and vertical velocities, the standard extrapolation conditions are accepted.

$$\frac{\partial^2 U}{\partial z^2} = \frac{\partial^2 V}{\partial z^2} = \frac{\partial^2 W}{\partial z^2} = 0.$$

Numerical scheme. The dimensionless Navier-Stokes equation in vector form will have the following form:

$$\frac{\partial \Phi}{\partial t} + U\frac{\partial \Phi}{\partial x} + V\frac{\partial \Phi}{\partial y} = \frac{\partial}{\partial z}\left(A\frac{\partial \Phi}{\partial z}\right) + \frac{\partial}{r\partial r}\left(A\frac{\partial \Phi}{\partial r}\right) + \frac{\partial}{r^2\partial \varepsilon}\left(A\frac{\partial \Phi}{\partial \varepsilon}\right) + \Pi^{\Phi}. \quad (3)$$

Here: $\Phi = \begin{pmatrix} U \\ V \\ W \\ T \end{pmatrix}$, $A^{\Phi} = \begin{pmatrix} \dfrac{1}{Re} \\[1mm] \dfrac{r}{Re} \\[1mm] \dfrac{r}{Re} \\[1mm] \dfrac{r}{RePr} \end{pmatrix}$, $\Pi^{\Phi} = \begin{pmatrix} \dfrac{\partial p}{\rho \partial z} \\[1mm] \dfrac{\partial p}{\rho \partial r} \\[1mm] \dfrac{\partial p}{\rho \partial \varepsilon} \\[1mm] 0 \end{pmatrix}$.

McCormack's scheme. As is known, the McCormack method [11] is widely used to solve the equations of gas dynamics. McCormack's method is especially useful for solving non-linear partial differential equations.

Applying the explicit «predictor-corrector» method to the nonlinear Navier-Stokes equation, we obtain the following difference scheme:

Predictor:

$$\bar{\Phi}_{i,j,k} = \Phi_{i,j,k}^n - \Delta t\left(U_{i,j,k}^n \frac{\Phi_{i+1,j,k}^n - \Phi_{i,j,k}^n}{\Delta z} + V_{i,j,k}^n \frac{\Phi_{i,j+1,k}^n - \Phi_{i,j,k}^n}{\Delta r} + W_{i,j,k}^n \frac{\Phi_{i,j,k+1}^n - \Phi_{i,j,k}^n}{\Delta \varepsilon}\right) +$$
$$+\Delta t\left(\frac{\Phi_{i,j+1,k}^n - 2\Phi_{i,j,k}^n + \Phi_{i,j-1,k}^n}{Re\,\Delta r^2} + \frac{\Phi_{i+1,j,k}^n - 2\Phi_{i,j,k}^n + \Phi_{i-1,j,k}^n}{Re\,\Delta z^2} + \frac{\Phi_{i,j,k+1}^n - 2\Phi_{i,j,k}^n + \Phi_{i,j,k-1}^n}{Re\,\Delta \varepsilon^2} + \Pi^{\Phi}\right). \quad (4)$$

Corrector:

$$\Phi_{i,j,k}^{n+1} = \frac{1}{2}\left(\begin{array}{l}\overline{\Phi}_{i,j,k} + \Phi_{i,j,k}^n - \Delta t(U_{i,j,k}^n\frac{\Phi_{i,j,k}^n - \Phi_{i-1,j,k}^n}{\Delta z} + V_{i,j,k}^n\frac{\Phi_{i,j,k}^n - \Phi_{i,j-1,k}^n}{\Delta r} + W_{i,j,k}^n\frac{\Phi_{i,j,k}^n - \Phi_{i,j,k-1}^n}{\Delta \varepsilon}) + \\ +\Delta t(\frac{\overline{\Phi}_{i,j+1,k} - 2\overline{\Phi}_{i,j,k} + \overline{\Phi}_{i,j-1,k}}{\mathrm{Re}\,\Delta r^2} + \frac{\overline{\Phi}_{i+1,j,k} - 2\overline{\Phi}_{i,j,k} + \overline{\Phi}_{i-1,j,k}}{\mathrm{Re}\,\Delta z^2} + \frac{\overline{\Phi}_{i,j,k+1} - 2\overline{\Phi}_{i,j,k} + \overline{\Phi}_{i,j,k-1}}{\mathrm{Re}\,\Delta \varepsilon^2} + \Pi^\Phi)\end{array}\right). \quad (5)$$

This explicit scheme of the second order of accuracy with the approximation error $O\left((\Delta t)^2, (\Delta z)^2, (\Delta r)^2, (\Delta \varepsilon)^2\right)$ is stable for $U_{\max}\Delta t\left(\frac{1}{\Delta z} + \frac{1}{\Delta r} + \frac{1}{\Delta \varepsilon}\right) < 1$, which corresponds to the Courant conditions [12].

Initially, the (predictor) is found with the $\overline{\Phi}_i^{n+1}$ value and at the $n+1$-th time step, and then the (corrector) is determined by the final value of Φ_i^{n+1} at the $n+1$-th time step. Note that the predictor is approximated by forward differences, and the corrector is approximated backward by differences.

A similar scheme was used for transverse speed. A feature of discretization is that the finite difference approximation is centered according to the chosen pattern. In this case, the grid indices for the dependent variables turn out to be shifted.

The velocities obtained according to schemes (5) do not satisfy the continuity equation. Therefore, following the SIMPLE procedure [13], we introduce a pressure correction $\delta p_{i,j}$ that satisfies the condition

$$\begin{cases} U_{i,j}^{n+1} = U_{i,j}^n - \Delta t\frac{\partial\delta p_{i,j}}{\partial x}, \ V_{i,j}^{n+1} = V_{i,j}^n - \Delta t\frac{\partial\delta p_{i,j}}{\partial y} \end{cases} \quad (6)$$

Now, substituting the velocities $\tilde{U}_{i,j}^{n+1}$, $\tilde{V}_{i,j}^{n+1}$ into the continuity equation, it is easy to obtain the following equation

$$\left(\frac{\delta p_{i+1,j} - 2\delta p_{i,j} + \delta p_{i-1,j}}{\Delta x^2}\right) + \left(\frac{\delta p_{i,j+1} - 2\delta p_{i,j} + \delta p_{i,j-1}}{\Delta y^2}\right) = \frac{1}{\Delta t}\left(\frac{U_{i+1,j}^{n+1} - U_{i-1,j}^{n+1}}{2\Delta x} + \frac{V_{i,j+1}^{n+1} - V_{i,j-1}^{n+1}}{2\Delta y}\right). \quad (7)$$

To solve equation (7), we used the iterative method of upper relaxation. Thus, according to (5), intermediate values of the parameters are determined, then, according to equation (7), the correction pressure is determined. Therefore, the pressure on time layer $n+1$ will be equal to $p^{n+1} = p^n + \delta p$.

Figure 3 shows a difference grid in which 973128 cells are used.
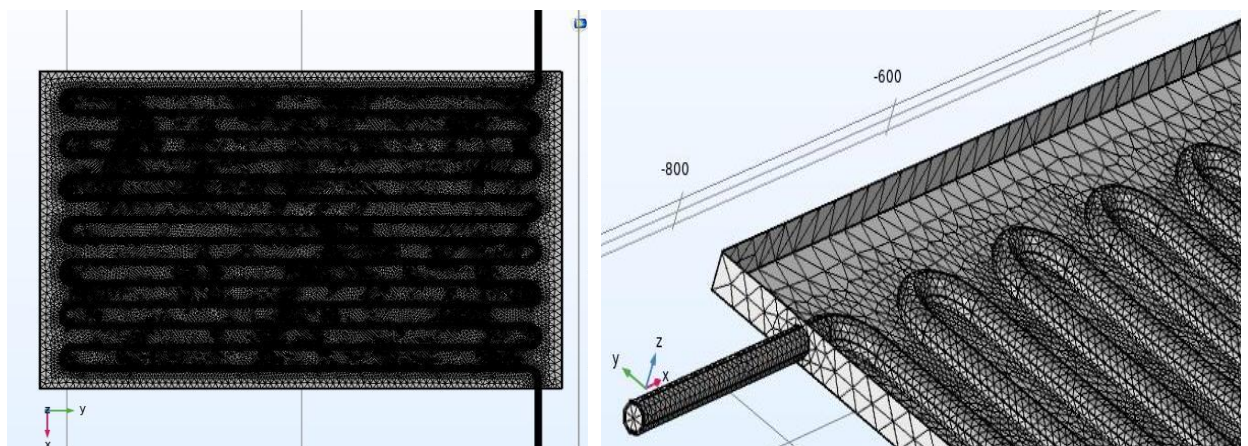
Figure 3. General view of the difference grid

Figure 4 shows the results of determining the longitudinal flow velocity at various sections of the flow channel, with the Reynolds number $\mathrm{Re} = 500$.
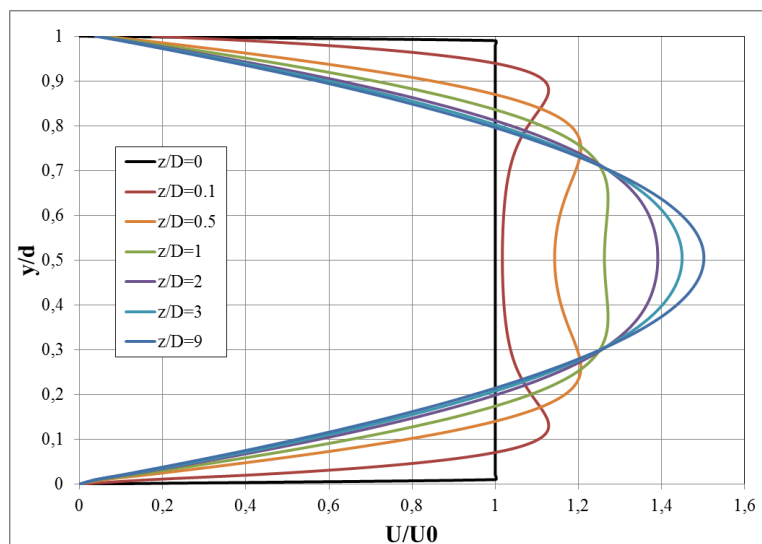
Figure 4. The results of determining the longitudinal flow velocity at various sections of the flow channel

It can be seen from (Fig. 4) that the flow in sections $z/D = 9$ has a laminar profile. (Fig. 5) shows the results of heat distribution when the valve is opened at different times.

a)

b)

c)

d)
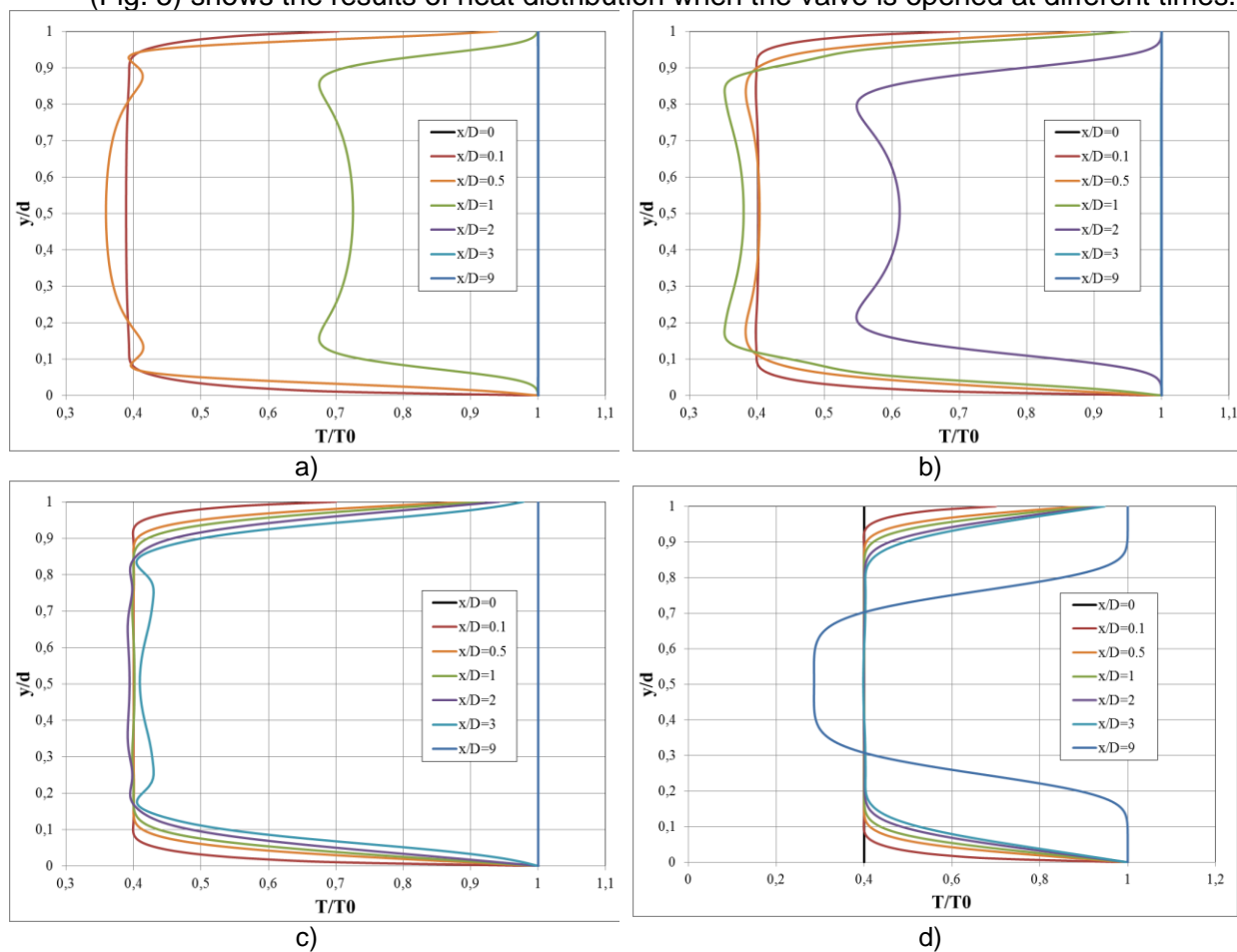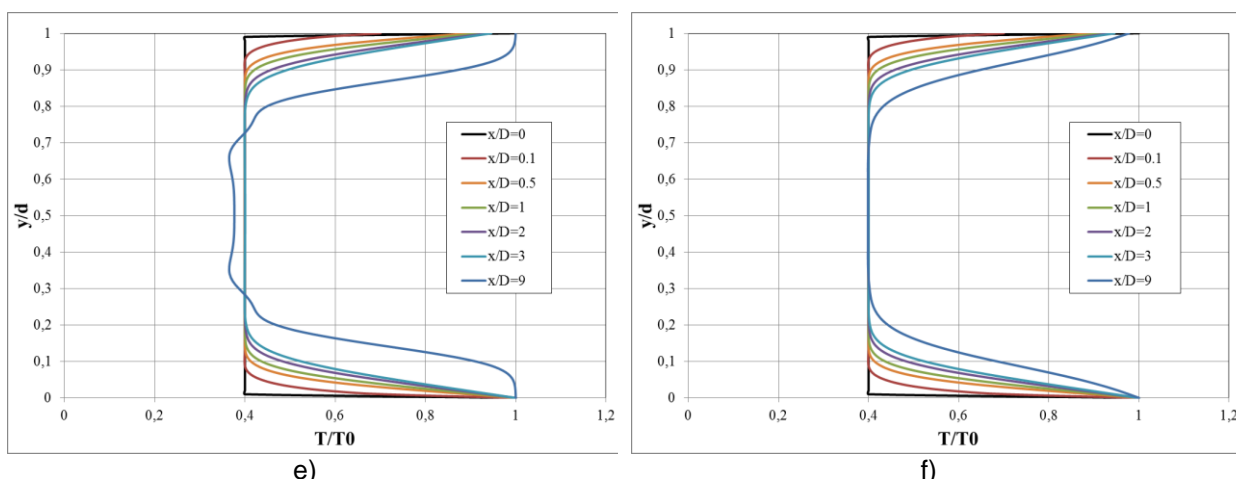
Figure 5. The results of heat distribution over time:
a) T = 1 s; b) T = 2 s; c) T = 5 s; d) T = 8 s; e) T = 10 s; f) T = 15 s

Figure 6 shows the heat distribution isoline and isotherm
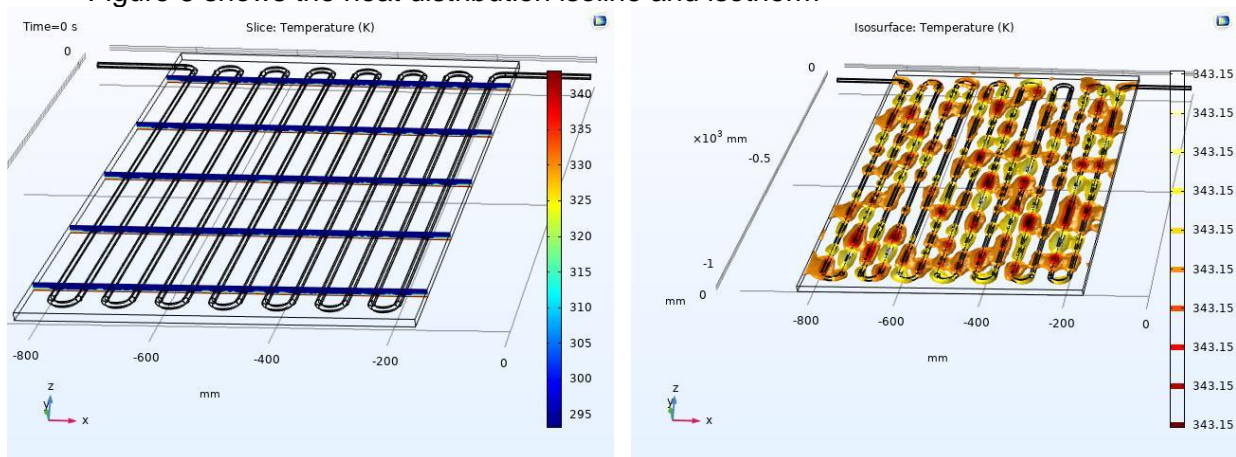
Figure 6. Isolines of heat distribution and isotherms

Conclusion. In engineering practice, when calculating the heat and power indicators of thermal absorbers, the use of the Comsol Multiphysics 5.6. allows you to speed up the process of calculating their heat transfer and hydrodynamics, to create a difference grid for introducing initial and boundary conditions for the calculation. The number of cells in the difference grids depends on the tolerances provided by the standards for the calculation of heat exchange processes. Depending on the Reynolds number and the diameter of the channel of the thermal absorber, it is possible to determine the stabilization section, the laminar flow section, as well as the fluid velocity and heat transfer, respectively.

Developed on the basis of the program "Comsol Multiphysics 5.6." a simulation model of heat transfer from a photovoltaic battery to a heat absorber can be used to calculate heat and power supply systems.

The use of a simulation model in the design of heat and power supply systems makes it possible to reduce the consumption of heat and electricity.

References

1. https://thescipub.com/PDF/ajassp.2014.1927.1937
2. Нигматов, У. Ж., & Наимов, Ш. Б. (2020). Анализ потенциала использования энергии солнечного излучения на территории Республики Таджикистан. In *International scientific review of the technical sciences, mathematics and computer science* (pp. 59-71).
3. Эргашев, С. Ф., Нигматов, У. Ж., Абдуганиев, Н. Н., & Юнусов, Б. С. А. (2018). Солнечные параболоцилиндрические электростанции-современное состояние работ и

перспективы использования их в народном хозяйстве Узбекистана. *Достижения науки и образования*, (5 (27)).

4. Эргашев, С. Ф., & Нигматов, У. Ж. (2020). Солнечные параболоцилиндрические установки, конструктивные особенности и расчёт отдельных параметров. *Universum: технические науки*, (11-5 (80)).

5. Эргашев, С. Ф., Нигматов, У. Ж., & Пулатов, Э. У. У. (2018). Анализ перепадов температур, возникающих в тепловых трубах солнечных параболоцилиндрических установок. *Проблемы науки*, (5 (29)).

6. Эргашев, С. Ф., Нигматов, У. Ж., Орипов, А., & Ощепкова, Э. А. (2019). Энергоэффективный трекер без использования светозависимых датчиков (Фоторезисторов, фотодиодов И ТД). *Известия Ошского технологического университета*, (3), 234-236.

7. Нигматов, У. Ж. (2020). Анализ конструктивных элементов охлаждения гибридных солнечных коллекторов. *Вестник науки и образования*, (2-3 (80)).

8. Рахимов, Р. Х., Эргашев, С. Ф., Абдурахмонов, С. М., & Нигматов, У. Ж. (2017). Автоматизированная компьютерная система измерения производительности солнечных водонагревателей с порционной подготовкой горячей воды. *Computational nanotechnology*, (1).

9. Rakhimov, R. K., Irgashev, S. F., Abdurakhmanov, S. M., & Nigmatov, U. J. (2017). The automated computer system of measurement of productivity of solar water heaters from portion preparation of hot water. *Computational nanotechnology*, (1), 23-26.

10. Loitsyansky L. G. The mechanics of fluid and gas, Moscow, Science. p. 840, Mexanika jidkocti i gaza, Moscow, Nauka, (1987).

11. Robert S. Bernard, A MacCormack scheme for incompressible flow, Computers & Mathematics with Applications, Volume 24, Issues 5–6, 1992, Pages 151-168, ISSN 0898-1221, https://doi.org/10.1016/0898-1221(92)90046-K.

12. Jim Douglas Jr., On the errors in analogue solutions of heat conduction problems, Quart. Appl. Math. 14 (1956), P.333–335. MR 88805. DOI https://doi.org/10.1090/S0033-569X-1956-88805-1

13. Patankar, S.V. (1980). Numerical Heat Transfer and Fluid Flow (1st ed.). CRC Press, P. 200. https://doi.org/10.1201/9781482234213

PROCUREMENT OF LOCAL RAW MATERIALS COMPLEX FERTILIZERS WITH NITROGEN-PHOSPHATE-POTASSIUM CONTAINING MOISTURE

ABDUXAKIMOV TAL'ATJON

Doctoral student of Namangan Institute of Engineering and Technology
E-mail: talatbek1995@mail.ru, phone: (+99893) 484-62-29

SHERKUZIEV DONIYOR

Professor of Namangan Institute of Engineering and Technology

Abstract:

Objective. In the article, a study on obtaining complex fertilizers with a gel composition that preserves mineral components by introducing local raw materials FarPAN, organic and inorganic acids and MAP (monoammonium phosphate), MPP (monopotassium phosphate) as fertilizers, N:P:K fertilizers with different ratios work has been done. The optimal parameters for the synthesis of the obtained moisture-retaining complex fertilizers have been determined.

Keywords: complex fertilizer with gel composition, FarPAN, monoammonium phosphate, monopotassium phosphate, NPK.

Introduction. At the beginning of the 21st century, generally accepted crop cultivation technologies cannot provide stable high yields, respectively, improve the quality of life of the population, due to various factors, such as adverse weather conditions, environmental pollution, soil degradation and salinization, etc. d. [1].

That is why the main task at the moment in agriculture is to increase soil productivity, its regeneration and restoration.

One of the main ways to solve the problem in agriculture and horticulture is to maintain the water-salt balance and improve the physicochemical and physical properties of the soil, as well as replenish it with nutrients necessary for the growth and development of living organisms.

For growth and sustainable development, plants need macronutrients: nitrogen, phosphorus and potassium, as well as microelements: Na, Ca, B, Cu, Fe, etc. The presence of nitrogen available to the plant plays the most important role in plant life. Being the main component of amino acids, it is part of the cytoplasm, hormones, vitamins, etc., the presence of nitrogen affects all stages of crop development: from the beginning of plant growth to fruiting. The lack of nitrogen at the first stage leads to a significant decrease in the yield of products, and at the second stage - to a decrease in its quality [2,3].

Potassium is most important for plants from the first days of their growth until flowering. The presence of potassium contributes to an increase in frost resistance and resistance of plants to diseases, increases the absorption capacity of the root system, and promotes the absorption of carbon dioxide from the air [4]. In particular, a lack of potassium at the first stage leads to a delay in the growth of cereal crops and a drop in yield, and at the second stage, to a deterioration in the quality and deterioration of the keeping quality of grain [5].

But the use of various types of fertilizers without the use of the most important substance on Earth - water, is impossible, since water not only ensures the solubility and flow of nutrients in plants, but also making up to 95% of the mass of plants, ensures the flow of all vital processes of the system.

However, at present there is a significant shortage of water associated with the irrational use of agricultural land, plowing, alkalinization, desertification, etc. [6].

One of the ways to solve the tasks set is the use of sorbents, which allow not only increasing the water-retaining capacity of soils, but also improving the structuring of soil aggregates [7–10].

A number of studies have been carried out in this aspect. In particular, preparation of a new core–shell slow-release fertilizer formulation was conducted through the coating of commercial NPK fertilizer with hydrogel/clinoptilolite (Hyd/CL) nanocomposite. The Hyd/CL nanocomposite was prepared from free radical polymerization of sodium alginate, acrylic acid, acrylamide, and clinoptilolite zeolite. The uniform coating on the surface of the fertilizer granules was verified by scanning electron microscopy. The swelling kinetics as well as the water-retention property and water absorption rate of the prepared samples was studied [11-13].

Taking into account the above, in order to develop agriculture, horticulture and farms, to meet the demand for phosphorous fertilizers in our country, a number of researches were carried out at the Namangan Institute of Engineering and Technology, the Scientific Laboratory of Chemical Technology of Inorganic and Organic substances. As the main raw

material of our research, FarPAN substance produced in Ferganazot in the territory of our Republic was used [14-20].

Materials and methods. For research work in this laboratory, FarPAN, formalin, organic acid, sulfuric acid, nitric acid and MAP (monoammonium phosphate), MKP (monopotassium phosphate) N:P:K (10:10:40) and N :P:K (10:52:10) was used to study the mechanisms of obtaining complex fertilizers containing mineral components. The research was conducted in a laboratory equipped with a special mixer (model OSO-20). In order to create gel-containing complex fertilizers, the initial substances were sequentially placed in a glass (1000 ml), mixed in a water bath and heated at a temperature of 70-75°C.

According to sample 1 obtained by the nitric acid method, the formation time of the gel-like mass was 32 minutes, by the sulfuric acid method it was 24 minutes, and by the sulfate+nitrate method it was 26 minutes. Among these samples, the level of water absorption showed that it was slightly higher compared to the remaining ones in the nitric acid method. The research was continued by introducing nitrogen-phosphorus-containing components, and the consumption of inorganic acids was taken as in sample 1 above. The environment and temperature of the mixture were monitored during the reaction for all 4 samples. The most important parameters in the synthesis of gel-containing complex fertilizers are listed in Table 1

Table 1

The most important parameters in the synthesis of gel-containing complex fertilizers

| Basic reagents for obtaining gel-containing complex fertilizer | Consumption rate of inorganic acids | | | | | | | | |
| | Nitrate method (HNO$_3$) | | | Sulfate method (H$_2$SO$_4$) | | | Sulfate+nitrate method (HNO$_3$+ H$_2$SO$_4$) | | |
	Growth medium (pH)	Production time (min)	Stuttering rate (times)	Growth medium (pH)	Production time (min)	Stuttering rate (times)	Growth medium (pH)	Production time (min)	Stuttering rate (times)
Farpan+formalin+Monoammonium phosphate	6,09	32	32	5,65	24	30	5,95	26	27
Farpan + formalin + monopotassium phosphate	5,78	19	24	6,13	6	23	5,42	20	21
Farpan + formalin + N.P.K (10.10.40)	5,91	43	21	5,82	22	18	5,74	37	15
Farpan + formalin + N.P.K (10.52.10)	5,98	31	28	6,01	25	26	5,89	34	20

In this table, we observed that the medium for the formation of gel-containing fertilizers (pH) was in the range of 5-6. In order to monitor the results of the analysis, the pH medium (model pHscan30S) was determined using the device. As can be seen from the table, the highest environment was formed by the sample

obtained with MPP fertilizer with nitric acid. The low indicator was the sample when we added MPP fertilizer in the presence of nitrate + sulfate.

Results and discussion. During the experiment, the formation times of each sample were also analyzed. The times analyzed in Table 1 were calculated after

the acid was poured at the last stage of raw materials in the production of gel-based fertilizers. The obtained samples were dried in a drying device at a temperature of 60◦C. It is presented in Fig. 1.

Figure 1. Complex fertilizer with gel composition. A) Sulfate + nitrate method (HNO₃+ H₂SO4) MPP fertilizer, V) Nitrate method (HNO₃) MAP fertilizer, S) Sulfate method (H₂SO₄) N:P:K (10:52:10) fertilizer

Figure 1. shows the collection of white salts during drying in the gel fertilizer MPP in the Sulfate+nitrate method (HNO₃+ H₂SO₄) in the sample in A) and in the sample in C) in the sulfate method (H₂SO₄) N:P:K (10:52:10) and it was observed that more white salts were collected during drying in the gel-containing fertilizer.
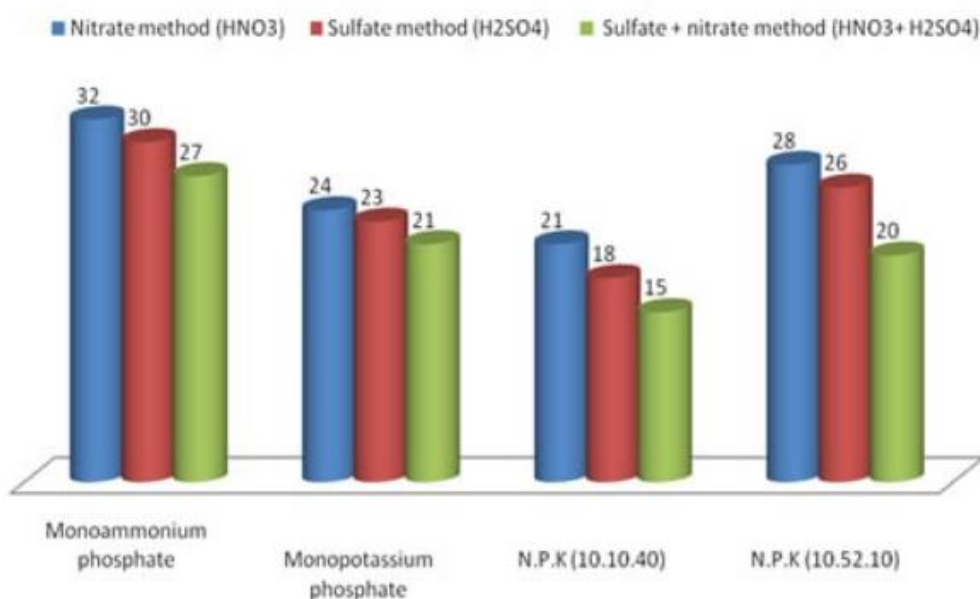
Figure 2. The diagram of the solubility of gel-containing complex fertilizers

In B) and D) samples, it was observed that this gel-based fertilizer, obtained by the nitric acid method, came out transparent. After that, the degrees of absorption of gel-containing fertilizers were studied. They are given in Figure 2.

For this, 1 g of samples were taken and 10 ml of water was poured into them. According to the obtained results, it was observed that the MAP gel-containing fertilizer obtained by the nitrate method was 32 times larger, and the N:P:K.

(10:10:40) gel-containing fertilizer sample by the sulfate method was 15 times larger.

Conclusions. From the laboratory analyzes obtained in this way, the environment and times of formation of complex fertilizers with gel composition were studied. The degrees of swelling calculated from the important indicators of the obtained samples were determined. In the future, it is planned to analyze the salts on the surface by physico-chemical methods after drying the samples obtained in gel-containing fertilizers with the presence of sulfuric acid. Translucent and moisture-retaining gel-complex fertilizers are used in agriculture, horticulture and farms as mineral fertilizers and water resource-saving complex fertilizers in water-scarce areas.

References

1. Проблемы деградации и восстановления продуктивности земель сельскохозяйственного назначения в России / под ред. академиков Россельхозакадемии А. В. Гордеева, Г. А. Романенко. – М.: Росинформагротех, 2008. – 67 с.

2. Агафонов, Е. В. Применение комплексных удобрений и азотной подкормки под озимую пшеницу / Агафонов Е. В., Громаков А. А., Максименко М. В. // Земледелие. - 2012. - № 7. - С. 16-17.

3. Phosphorus levels and phosphatic biofertilizers influenced yield, nutrient uptake and soil fertility under wheat (Triticum Aestivum l.) /Bairwa R. K., Purohit H. S., Meena R. H // Ecology, Environment and Conservation Paper. – 2013. – V-19. – I. 03. – P. 757-762.

4. Агеев, В. В. Система удобрения в севооборотах юга России. Учебное пособие / Агеев В. В., Подколзин А. И. - Ставрополь: ГОУ Ставропольская ГСХА, 2001 – 352 с.

5. Джанаев З. Г. Агрохимия и биология почв Юга России. Монография. / Под редакцией академика РАСХН В.Г. Минеева. – М.: Изд-во МГУ, 2008. – 502 с.

6. Земледелие: Учебники и пособия / С. А. Воробьев. Каштанов А. Н, Лыков М., Макаров И. П / под ред. С. А. Воробьева. - Москва: Агропромиздат, 1991. – 526 с.

7. Кирейчева, JI. В. Концепция создания устойчивых мелиоративных ландшафтов / Л. В. Кирейчева // Вестник РАСХН. – 1997.– № 5. – С. 51–55.

8. Стрельников, В.Н. Полимерный гидрогель в технологии орошения почв / Стрельников В.Н., Будников В.И., Синкин. В.В. // Аграрная наука. Почвоведение. – 2007. – № 10. – С.18-19.

9. Данилова Т.Н. Возможности использования гидрогелей для управления водообеспеченностью полей // Плодородие. – 2008. – №6. – С. 24-25.

10. Assessment of the impact of compost and hydrogel as soil moisture retainers on the growth and development of forege maize(Zea mays L.) / Yanez-Chavez Y., Pedroza-Sandoval L.G., Sánchez-Cohen A., Samaniego-Gaxiola J.A. // Journal of Agriculture and Environmental Sciences. – 2014. – Vol. 3 (4). – pp. 93-106.

11. Rashidzadeh, A., Olad, A., & Reyhanitabar, A. (2015). Hydrogel/clinoptilolite nanocomposite-coated fertilizer: swelling, water-retention and slow-release fertilizer properties. Polymer Bulletin, 72, 2667-2684.

12. Khan S, Hanjra MA (2009) Footprints of water and energy inputs in food production–Global perspectives. Food Policy 34(2):130–140.

13. Guo M, Liu M, Hu Z, Zhan F, Wu L (2005) Preparation and properties of a slow release NP compound fertilizer with superabsorbent and moisture preservation. J Appl Polym Sci 96(6):2132–2138.

14. Tal'At, A., Doniyor, S., & Khayrullakhan, A. (2022). Obtaining a new type of hydrogel by polymerizing farpan with formalin and various additives. Universum: технические науки, (4-13 (97)), 9-13.

15. Шеркузиев, Д. Ш., & Арипов, Х. Ш. (2020). Влияние гидрогеля на механический состав и агрохимические свойства неорошаемых почв. ВВК, 79, 859.

16. Abduhakimov, T., Sherkuziev, D., & Aripov, X. (2023, March). Obtaining of complex hydrogel fertilizers with moisture-retaining NPK based on local raw materials. In IOP Conference Series: Earth and Environmental Science (Vol. 1142, No. 1, p. 012055). IOP Publishing.

17. Shermamatovich, S. D., Davlatovich, S. S., Orifjonovich, Y. M., & Oydin, A. (2018). Hydrogel production of new generation based on local raw materials. European Science Review, 1(11-12), 141-145.

18. Sherkuziev, D. S., Aripov, K. S., Alimov, U. K., & Maxmudova, M. A. (2020, December). Research of agrochemical and mechanical properties of soils processed with hydrogel. In IOP Conference Series: Earth and Environmental Science (Vol. 614, No. 1, p. 012121). IOP Publishing.

19. Sherkuziev, D., Mamadrakhimov, A., Aripov, K., Mutalliev, L., & Namozaliev, A. (2021). Obtaining of hydrogel polymer by polymerization of hydrolyzed polyacrylonitrile with formalin in the presence of glycerin. German International Journal of Modern Science, (9), 7-10.

20. Sherkuziev, D. S., Shirinov, S. D., Yusupov, M. O., & Asqarova, O. (2018). Hydrogel production of new generation based on local raw materials. European Sciences review. Scientific journal, 1(11-12), 141.

UDC 678.01

STUDY OF THE STRUCTURE AND PROPERTIES OF POLYVINYL CHLORIDE FILLED WITH BAZALT MINERAL

TOJIEV PANJI

Associate Professor of Termez State University
E-mail: panjitojiyev74@gmail.com, phone.: (+99893) 591-60-45

TURAEV XAYIT

Professor of Termez State University
E-mail: hhturayev@gmail.com, phone.: (+99891) 579-06-33

NURALIYEV GAYRAT

Teacher of Termez State University
E-mail.: nuraliyev81@gmail.com, phone.: (+99893) 591-60-45

DJALILOV ABDILAXAT

Academician of the Academy of Sciences of the Republic of Uzbekistan
Tashkent Scientific Research Institute of Chemical Technology

Abstract:
Objective. At present, many scientific results are being achieved in our country on the use of local mineral fillers in the field of composite materials production. To date, the use of mineral products for the protection of polymeric materials and building horse fires and various aggressive environments is one of the urgent tasks.

89

The purpose of the work is to obtain heat-resistant and mechanically strong thermoplastic composite materials by filling polyvinyl chloride with basalt mineral.

Methodology. The physical and mechanical properties of filled polyvinyl chloride (PVC) composites were studied, the melt flow index was determined by the viscometric method, the bending strength was determined by the double-sided bending method, and the impact strength was determined by the Charpy method.

Results. The physico-mechanical and thermophysical properties of polyvinyl chloride filled with basalt-containing mineral have been studied.

Conclusion. To obtain a composite material based on PVC, the content of fillers was changed from 1 mass to 5 mass parts. An assessment of the rheological properties of filled composites showed that with an increase in the basalt content, the fluidity of the compositions decreases, however, the resulting compositions can be processed by injection molding. The data obtained show that the optimal compositions are those containing: 5 wt.h. basalt fillers.

The developed materials were studied for flammability by the oxygen index method, and thermophysical properties by the DTGA method.

Keywords: polyvinyl chloride, basalt fibers, atomic force microscopy, physicochemical and mechanical properties.

Introduction. Today, the modern development of the economy increases the demand for thermoplastic polymeric materials, but manufacturers cannot satisfy the needs of consumers in polymeric materials used in various fields [1]. By introducing various mineral additives into the composition of polymers, it is possible to significantly improve the quality of polymers and the properties of composite materials based on them, which makes it possible to expand their range and scope. [2-5].

Currently, there are various types of mineral fillers for polymers, and their number is increasing every year, which makes it possible to expand the scope of polymeric materials.

The development of the modern economy requires the production of polymer composite materials not only with high properties, but also with low prices. Therefore, to improve the properties of composite materials, it is advisable to use basalt and basalt fibers, which are cheap and effective fillers.

One of the unique properties of basalt is that it is refractory and can withstand temperatures up to $900^0C-1400^0C$, resistant to chemical and mechanical stress, has high thermal insulation properties, biological stability, and chemical neutrality - resistant. to aggressive acidic and alkaline environments, does not accumulate radiation. Basalt minerals are an environmentally friendly material, harmless to humans and animals [6].

Methods and materials. The object of study was a thermoplastic composite material based on polyvinyl chloride. The melt flow index was determined according to GOST 11645-73 at a load of 2.16 kg and a temperature of 463 and 503 K. To determine the melt flow index, an IIRT-M brand viscometer with a capillary length and diameter of 8 and 2.09 mm, respectively, was used. the bending was determined by the two-pore bending method according to GOST 6806-73.

Results and discussion. In this work, the problem of improving the mechanical properties of composite materials based on polyvinyl chloride filled with basalt-containing fillers was solved.

The aim of the work is to obtain composite materials based on polyvinyl chloride filled with basalt-containing fillers and to study their physical and mechanical properties [8].

Development of studies of the obtained materials based on polyvinyl chloride containing nanoscale modifiers that affect the supramolecular structure of polymer macromolecules and thus its physical and mechanical characteristics.

Experimental part. Chemical modification by introducing new functional groups into the polyvinyl chloride macromolecule and the study of their physico-mechanical and chemical

properties from a scientific and practical point of view are of great importance [9].

We used basalt from the Asmansay deposit in the Jizzakh region, the composition of which is given in Table 1.

The development of basalt rocks from the Asmansay deposit in the Jizzakh region fully meets the republic's need for mineral fiber and exports it abroad [7].

Table 1.

Chemical composition of basalt from the Asmansay deposit

Component	Content, % wt. basalt
Silicon oxide SiO_2	47,0
Magnesium oxide, MgO	16,3
Aluminum oxide Al_2O_3	11,2
Iron oxide Fe_2O_3	10,3
Calcium oxide, CaO	8,94
Sodium oxide, Na_2O	1,53
Potassium oxide, K_2O	0,33
Iron oxide FeO	0,16
Titanium oxide TiO_2	0,57
Manganese oxide MnO	0,19
Sulfur oxide, SO_3	less 0,05
Other rock impurities	2,04

To obtain a composite material, the basalt mineral was crushed in a ball mill for 5 hours to 140 μm, and polyvinyl chloride (PVC) was used as a binder.

When choosing the optimal filler particle size, basalt minerals were used in the composition of PVC-based composite materials with particle sizes of 125 and 315 μm, and their physical and mechanical properties were studied.

The amount of dispersed fillers in the polymer matrix was 40%. This amount is the optimal composition for composite materials based on basalt mineral and polyvinyl chloride [8].

The rheological properties of composite materials obtained on the basis of basalt mineral and polyvinyl chloride were determined by the melt flow index (MFR). With an increase in the amount of basalt in the composition of PCM, the melt flow decreases (Table 2), but these composites can be processed by injection molding

Table 2.

Change in the melt flow index of the composition at 200⁰C depending on its composition (particle size ≤140 μm)

The composition of the composition, wt.h., per 100 wt.h. PVC	PVC PTR, g/10min,
PVC	5,36
PVC+30basalt	3,22
PVC+40basalt	2,78
PVC+50basalt	2,15

Determination of the physico-mechanical properties of composite materials showed that as a result of the inclusion of up to 40% basalt-containing fillers in the composition, all the physico-mechanical properties of the PVC-based polymer composite material are improved (Table 3). At the same time, it was noted that an increase in tensile strength leads to a decrease in relative elongation.

Comparative characteristics of the physical and mechanical properties of the developed PVC

The composition of the composition, wt.h., per 100 wt.h. PVC	impact strength kJ\m2	Elongation at break, %	Tensile strength, MPa
PVC	29	1245	9,12
PVC+30 basalt (BT)	41,2	96,6	9,9
PVC+40 basalt (BT)	62,6	35,4	11,6
PVC+50 basalt (BT)	54,9	12	10,9

The inclusion of dispersed basalt in the polymer composition affects the combustibility of PCM, reducing the self-combustion time of the composite material by 2 times compared to the original polyvinyl chloride, and also reducing the mass loss during ignition in air by 50% (Table 4).).

All indicators of the flammability of the polymer composite material indicate that the basalt mineral used as a filler has the ability to reduce flammability.

Atomic force microscopy (AFM) is widely used to study the topography and microstructure of various materials. This method makes it possible to form the surface of a sample obtained in the nanoscale range on a three-dimensional surface. The results obtained show a change in the size, shape, surface of particles and mechanical properties of particles on the surface of a polymer composite material [13].

The influence of the amount of basalt on the flammability of polyvinyl chloride

The composition of the composition, wt.h., per 100 wt.h. PVC	Weight loss upon ignition in air, %	Self-burning time, sec.
PVC	55	236
PVC+40 basalt(BT)	23	123
PVC+50 basalt(BT)	21	112

Using this method, the effect of modified filler particles on the polymer surface morphology was studied. The study and analysis of the surface of the modified polyvinyl chloride shows the distribution of dispersed basalt between polymer macromolecules and the features of their interaction. [14-15].
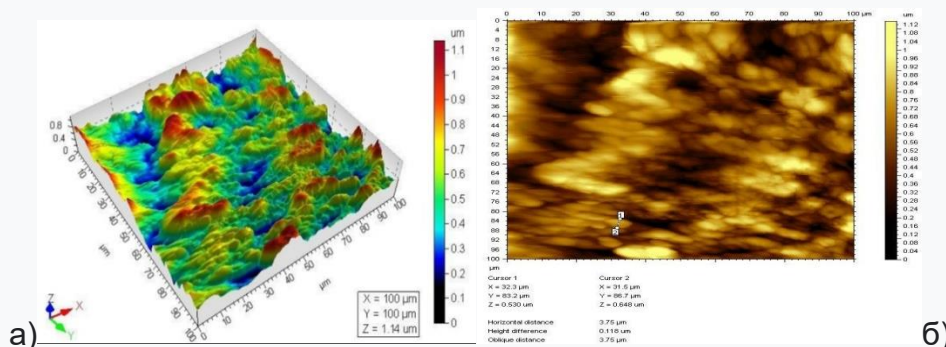

Figure 1. PVC + 40%BT: A) - three-dimensional image, B) - two-dimensional image

The size of the scanning range was 1-50 µm. On fig. Figure 1 shows the surface of a composite material containing PVC + 40% BT modified with dispersed basalt.

The results show that the surface roughness of the original PVC is 100 nm, and the surface roughness of the PVC + 40% BT composite is 210 nm [16].

Thermal-oxidative properties of composite materials have been studied on the basis of thermoanalytical studies.

It is known that polymer composite materials filled with basalt minerals decompose at a higher temperature than unfilled polymers, and this decomposition is characterized by the formation of an ash residue. This indicates the thermal stability of the obtained composite materials. The complex physical and mechanical properties of composite materials are determined on the basis of chemical changes during the processing of polymers. such as melting point change and heat resistance.

These processes take place at high temperatures. In this work, the thermal and thermophysical properties of polymer composite materials, such as the change in melting temperature and heat resistance, were studied. The melting temperature and degree of crystallization of polymer composite materials were determined by differential scanning calorimetry (DSC). The results obtained are presented in table. 5.

Table 5.

Thermodynamic properties of composite materials based on PVC + 40% BT

The composition of the composition	Start melting, $T°$ C	melting peak я, $T°C$	Enthalpy, ΔH, Дж/г	Degree of crystallinity α, %
PVC	160	224	188	55
PVC+30% BT	186	243	198	61
PVC+40% BT	197	245	204	59
PVC+550% BT	209	246	210	58

To determine the range of operating temperatures of polymer composite materials by differential scanning calorimetry (DSC), thermograms of the samples were taken.

A comparative analysis of the diffraction spectra of composite materials on fillers showed that the greater the interlayer distance of the modified fillers and the higher the filler concentration, the higher the diffusion rate of the filler included in the composition. Also, the degree of dispersion of fillers in the polymer depends on the duration of mixing of the components and the viscosity of the solution.

Accurate results can be obtained by experimental study of the size and shape of particles by X-ray phase analysis (Debye-Scherrer method). The size of coherent distribution zones (CZR) (the size of nanocrystals) is determined by the Debye-Scherrer formula:

$$Dp = K \lambda / (B \cos \theta)$$

Dp is the average crystal size (nm) K-Scherrer constant. K varies from 0.68 to 2.08. For spherical crystals with cubic symmetry K = 0.94.

Wavelength I λ -beams Cu Ka = 1.54178 Å.

B is the integral length of the reflections in the FWHM diffractometer (full width at half maximum). cosθ - cosine angle of X-ray diffraction.

Table 6.

Results of calculating the size of composite nanoparticles based on PVC + 40% BT according to the Debye-Scherrer formula

№	2theta-Scan Angle	FWHM-integral reflection width	Dp (nm) average crystallite size	Dp (nm) average
1	8.3	0.5	17.42	
2	8.7	0.6	14.61	15.61
3	21.4	0.65	15.12	
4	24.5	0.64	15.70	
5	26.4	0.66	15.23	

According to the results of X-ray phase analysis, it was found that the particle size in the obtained composite materials is nanosized.

Thus, the maximum amount of basalt mineral added as a filler to improve the physical and mechanical properties of polymer composite materials based on polyvinyl chloride was 40%.

All the obtained results showed that the addition of 40% dispersed basalt to polymers increases the strength and thermal stability of polymers.

Conclusion. Thus, an increase in the physical, mechanical and thermophysical properties of polyvinyl chloride filled with dispersed basalts is most effective when using PVC + 40% BT.

Composite materials based on polyvinyl chloride with mineral fillers and surfactants can be widely used as effective heat-resistant polymeric materials.

The phase structure of polyvinyl chloride modified with dispersed basalts can be explained by strong adhesion between the polymer base and fillers.

Modification of the polymer with mineral fillers leads to an increase in their fire resistance.

References

1. Umarov Sh.Sh., Tojiyev P.J., Turaev Kh.Kh., Jalilov A.T. Structure and properties of polymers filled with metal oxides // Tashkent : Uzbek chemical journal, 2021, №4, bet -pp.18-24 (in Russian)

2. Dusanov R.Kh., Tozhiev P.Zh., Turaev Kh.Kh., Jalilov A.T. Structure and properties of polyamide-6 filled with vermiculite Universum: chemistry and biology: electronic scientific journal. -2020.-№10(76). pp. 54-57 (in Russian)

3. GOST 11645-73. Plastics. Method for determining the melt flow rate of thermoplastics. Enter. from 01.01.1975. M .: p. 12 (in Russian)

4. GOST 9550-81 (Plastics. Methods for determining the modulus of elasticity in tension, compression and bending) Vved. from 26.08.1981 p. 15(in Russian)

5. GOST 4647-80. Plastics. Method for determining the Charpy impact strength. Enter. from 01.06.1981, S.27(in Russian)

6. GOST 11262-80. Plastics. Tensile test method. Enter. from 01.12.1980, P.16 (in Russian)

7. GOST 4651-2014. Plastics. Compression test method. Enter. from 01.03.2015. M .: Standartinform, 2014, S.20 (in Russian)

8. Chukov N.A. Composite materials based on polypropylene and nanoscale fillers: dissertation for a candidate of technical sciences: - Nalchik, 2011. - 110 p .: ill. RSL OD, 61 11-5 / 1845 (in Russian)

9.Henini M., Quantum Dot Nanostructures // Materials Today. - 2002. - V. 48. –P. 140-142. (in English)

10. Kiviranta L., Kumpulainen S. Quality Control and Characterriation of Bentonite Materials // PosivaOY.– 2011. - P.102. (in English)

11. Egorova O.V. Directed regulation of the structure and properties of polyethylene filled with dispersed fillers / OV Egorova, Yu.A. Kadykova, S.E. Artemenko // Plastic mass. - 2012. - No. 4. - S. 57-59. (in Russian)

12. Tojiev P.J., Normurodov B.A., Turaev Kh.Kh., Nurkulov F.N. *, Jalilov A.T. * Study of the physical and mechanical properties of highly filled polyethylene compositions // UNIVERSUM: Chemical technology: electronic scientific journal 2018 No. 2 (47). (in Russian)

13. Mozzhukhin V.B. Influence of technological equipment and technology for obtaining highly filled compositions based on polyolefins on their physical and mechanical properties / VB Mozzhukhin et al. // Plastics. - 2013. - No. 1. - P. 54–56.

14. B.A. Normurodov, P.J. Tojiev, Kh.Kh. Turaev, A.T. Djalilov, F.N. Nurkulov Study of physical and mechanical properties of basalt-containing polyethylene compositions // Tashkent: Composite materials-2017.-№ 4.-C.10-12 (in Russian)

15. B.A. Normurodov, P.J. Tojiev, Kh.Kh. Turaev, A.T. Djalilov Synthesis and IR-spectroscopic study of sulfur-containing oligomer// UNIVERSUM: Chemistry and Biology: electronic scientific journal 2018 No. 2 (44). (in Russian)

16. Kryzhanovsky, V.K. Production of products from polymer materials textbook / VK Kryzhanovsky and [others]. - SPb. : Profession, 2014 .-- 592 p. (in Russian)

17. Bredikhin P.A., Kadykova Yu.A. Investigation of the properties of PCM filled with dispersed basalt // V International student electronic scientific conference "Student scientific forum" - 2013. (in Russian)

18. Kerber M.L., Bukanov A.M., Wolfson S.I., Gorbunova I.Yu., Kandyrin L.B., Sirota A.G., Sheryshev M.A. Physical and chemical processes in the processing of polymers. - SPb.: Nauchnye osnovy i tekhnologii, 2013.

19. Guseva M.A., Structure and physical-mechanical properties of nanocomposites on the basis of non-polar polymers and layered silicates: Autoref. Dis. Cand. phys.-math. science Moscow: INXS RAN, 2004.

20. Kompozity na osnove polyolefinov / Pod ed. D. Nwabunmy, T. Cue. Per. s engl..-SPb.: NOT, 2014.

21. Osama Abdulkarim Al Khelo Materialy na osnove polypropylene with adjustable properties. Dissertation. sugar tech. science Moscow: RXTU, 20014.

22. Shitov D.Yu., Kravchenko T.P., Osipchik V.S., Rakov E.G. Kompozitnye materialy na osnove polypropylenea s korbonnymi nanopolnitelyami // Plasticheskie massy, No. 2, 2013. S. 29-33.

UDC 667.287.5

INVESTIGATION OF PHTHALOCYANINE DIAMIDOPHOSPHATE-COPPER BY THERMAL ANALYSIS

YUSUPOV MUZAFAR

PhD of Namangan Institute of Engineering and Technology
E-mail: muz.yusupov90@gmail.com, phone: (+99893) 570-77-54

Abstract: The article presents the results of a study of the synthesis of a new type of pigment - copper phthalocyanine diphosphate (DAPCuPc), which contains macroheterocyclic compounds. The influence of the method of obtaining a pigment in the liquid and solid phases on its physicochemical properties and intensity has been studied. The gross formula of the pigment is given and the areas of its practical application are shown. Thermal analysis on a Setaram LabSys Evo instrument (France) was used to study the thermal stability of a highly intense pigment of the organic copper phthalocyanine pigment, which was compared with the closest analog, the copper phthalocyanine pigment. The results of the mass

loss of the pigment upon heating are presented. It is shown that, due to the content of phosphorus-containing compounds, the synthesized pigment has high heat resistance and intensity. Thermal studies of exothermic and endothermic processes were carried out in the temperature range of 100-500 °C.

Keywords Phthalocyanine pigment, thermal analysis, exothermic, endothermic, copper diamidophosphate, phthalic anhydride, intensity.

1. Introduction. Today, there is a scientific basis in the world for solving a number of problems to improve the properties of phthalocyanine-based pigments and their effective use, including: simplification and safety of methods for the synthesis of phthalocyanine pigments; creation of new types of phthalocyanine pigments soluble in water and solvents; increased production of phthalocyanine pigments. It is necessary to find and expand the scope of new compositions that can purposefully change the anticorrosion, static and dynamic strength properties of phthalocyanine pigments [1].

At present, advanced technologies are being developed in the world, such as the production of electrical and optical materials based on phthalocyanine pigments, solar cells, and chemical sensors. An important advantage of phthalocyanine pigments is their very low toxicity; they are used in the production of packaging materials for food products, children's toys, and medicines. Also, phthalocyanines and their derivatives play an important role in obtaining light and heat resistant dyes, which are characterized by high chemical resistance and color stability [2].

About 25% of the volume of organic pigments produced are phthalocyanine pigments. In this regard, phthalocyanines containing nitrogen and phosphorus-containing groups are of particular scientific and practical interest. In this case, it is possible to obtain varnish coatings in the presence of phthalocyanine pigments [3].

Phthalocyanine is a planar 18 π-electron heterocyclic aromatic system with an alternating nitrogen and carbon ring structure derived from porphyrin. Phthalocyanines have been known for over 70 years and are widely used as dyes. Moreover, they have generated interest for various applications such as liquid crystals, photosensitizers, non-linear optics, solar cells, catalysis, and various chemical sensor applications. The peripheral and non-peripheral positions of the benzene ring of phthalocyanines can be replaced by many other molecules to impart new properties[4].

Probably, there is no such area of modern science in which the possibilities of using the properties of phthalocyanines would not be investigated, as evidenced by a huge number of publications [5].

The most interesting and in demand are the photophysical properties of Pcs [6]: high extinction and, in some cases, intense luminescence, the possibility of controlling the position of absorption/emission maxima, nonlinear optical characteristics, etc. Their combination with high (thermo)chemical stability and the ability to sublimate without decomposition, which makes it possible to obtain mechanically strong layers up to 100 μm thick with reproducible electrophysical characteristics, makes it easy to obtain various optoelectronic devices based on Pcs: in materials for creating charge memory in the manufacture of CD / DVD - discs, photosensitizers, chemosensors, light emitters [7], optical limiters, and photorefractive materials [8]. A number of semiconductor structures based on Pcs have a significantly increased photocurrent signal in the near IR spectral region and open up prospects for creating new generation solar energy devices [9]. Water-soluble phthalocyanines are used as sensitizers in photodynamic therapy of oncological diseases [10], in coatings and matrices of conducting polymers and artificial lipids immobilized on electrodes [11].

Complexes of phthalocyanines with transition metals have found application as

catalysts for the purification of hydrocarbons from sulfur compounds and in the neutralization of toxic effluents. Heterogeneous catalysts obtained by fusing a mixture of CoPc with salts of metals of variable valence onto a polymer matrix are highly efficient [12].

Phthalocyanine derivatives with mesomorphism can serve as "structural action" additives in the composition of tribologically efficient and environmentally friendly lubricants. Promising is the use of

Pcs in the composition of solid layered lubricants (TLS) and plastic lubricants (PS), which have a long service life at temperatures above 180°C, high moisture resistance, and good colloidal stability. On the basis of Pcs, it is planned to create permanent triboactive lubricating compositions for friction units [13].

Thus, due to the unique combination of valuable properties, Pcs derivatives are widely used in many branches of modern materials technology (Figure 1.).
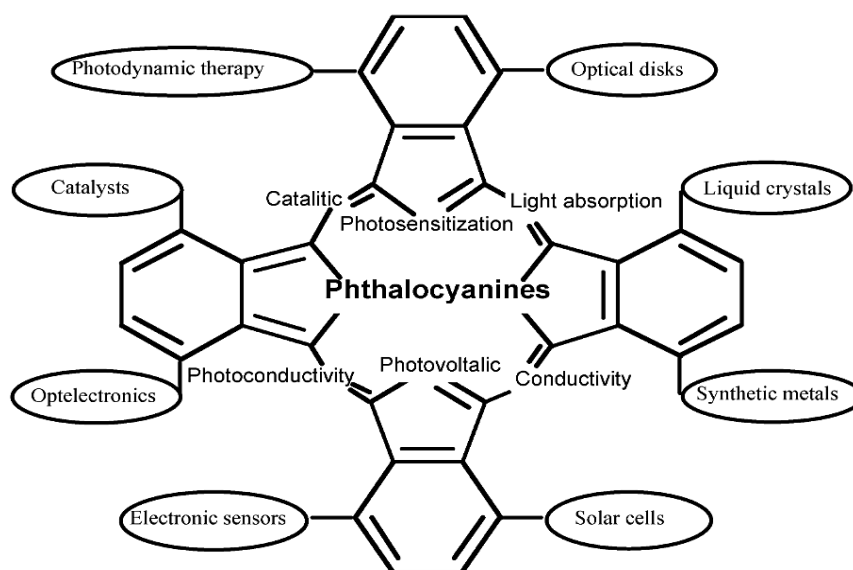
Figure 1. Modern applications of phthalocyanines. Further, aspects of the use of phthalocyanines that are directly related to this work are considered in more detail

2. Experimental Methodology. Synthesis of copper phthalocyanine (DAPCuPc) based on diamidophosphate. The synthesis was carried out in two ways: in a solvent medium and by heating at high temperatures [3].

1-way. Synthesis was carried out at high temperature by heating. 9.8 g (0.1 mol) of phosphoric acid and 18 g (0.3 mol) of urea were loaded into a beaker, stirred with a glass rod until urea was completely dissolved in phosphoric acid at 130 °C, then a mixture of the remaining ingredients was added, which consist from: 7 g (0.04 mol) copper(II) chloride, 6 g (0.1 mol) urea, 24 g (0.17 mol) phthalimide. After adding all the reagents, the reaction mass was stirred

and the catalyst was added in an amount of 1 % by weight of phthalimide. The reaction mass is mixed until homogeneous (red). The reaction mixture is heated to 260 °C for 3 hours. The resulting powder reaction mixture is cooled to 50 °C and 85 % sulfuric acid is added in the amount necessary to completely dissolve the resulting powder. Further, hot water is added to this mixture, while the pigment is deposited on the bottom of the vessel, the liquid is decanted, the pigment is washed with hot water and filtered. The resulting pigment is dried in a drying cabinet at 50-60 °C until completely dry. Product yield 80%.

2-way. For this, 73.6 g (0.4 mol) of diamidophosphate, 24 g (0.4 mol) of urea,

235.6 g (1.6 mol) of phthalimide, 70.8 g (0.4 mol) of copper(II) chloride (II). To the mass of copper acetate and phthalimide add 1% ammonium heptamolybdate and 550 ml of dimethyl sulfoxide (DMSO) as a solvent. The reaction is carried out at a temperature of 150-180 °C for 3-4 hours with stirring. Upon completion of the reaction, the reaction mass is cooled and filtered on a Buchner funnel, and the dark turquoise pigment remaining in the funnel is again washed with distilled water. The washed product is dried in an oven at 50 °C. Product yield 93%.

3. Results and its discussion. The new pigment diamidophosphate-copper-phthalocyanine (DAP-CuPc) was obtained in two different ways. Based on the results obtained, the second method was chosen. The proposed reaction mechanisms and the formula of the resulting substance are based on elemental analysis and IR spectral analysis:

Figure 2. New pigment, diamidophosphate-copper phthalocyanine (DAPCuPc)

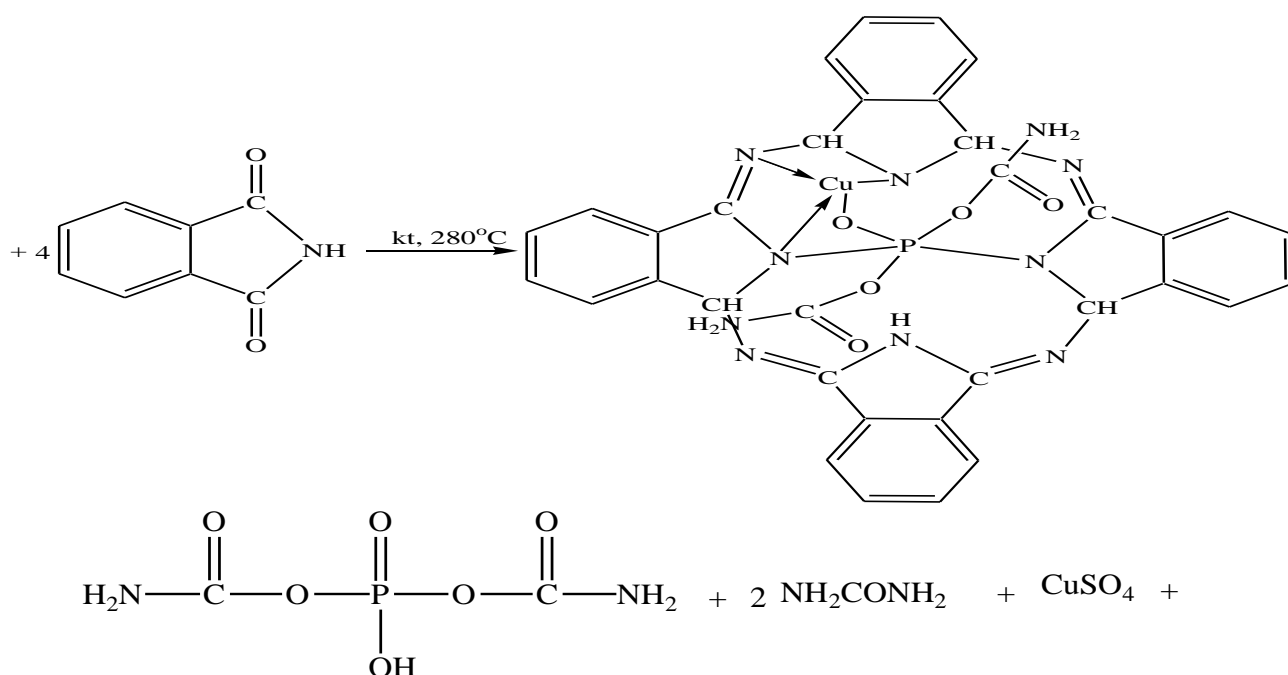To study the thermal properties of the resulting pigment, thermal analysis was carried out, the result of the derivatorgaf is shown in Figure 3
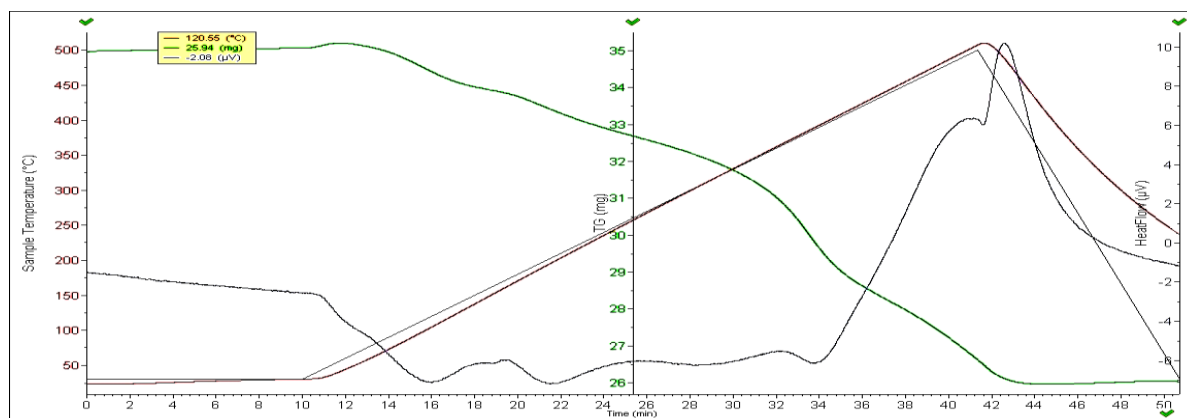

Figure 3. Derivatogram of the DAP-CuPc pigment

For the DAPCuPc pigment, a temperature above 500 °C was chosen, and as a result of pigment analysis, four endothermic effects were observed at temperatures of 30, 45, 51, 375 °C and three exothermic effects at 53, 390, 510 °C, the mass of the DAPCuPc pigment decreases due to residual moisture and adsorbed water of the internal structure of the complex. A subsequent mass loss was observed at 300 °C, the initial mass was 35 mg, and the amount of energy consumed at this temperature was 5.05 µV·s/mg. The decrease in mass is associated with the decomposition of nitrogen derivatives in the DAPCuPc pigment and carbon-bound compounds in the ring. Thermal analysis was carried out up to 500 °C and the total mass loss was calculated for each temperature separately. The DAPCuPc pigment retains a residual weight of 26,5 mg due to molecules that form a bond with phosphorus, and the weight of the pigment is reduced by 9.5 mg from the total weight obtained by keeping it at this high temperature for 37 minutes. According to the results of the analysis, the newly synthesized DAPCuPc pigment has the form of randomly arranged particles; amorphous. Table 1 shows a comparison of the thermal analysis of the DAPCuPc pigment and the copper phthalocyanine pigment.

Table 1

Comparative thermal analysis of the DAPCuPc pigment and the copper phthalocyanine pigment obtained as a control

№	Temperature °C	Residual mass, mg	Lost weight, mg	Lost weight, %	Power consumption (µV*s/mg)
		received 35 mg of pigment DAP-CuPc with a total mass			
1	100	34.4	0.6	1.71	2.6
2	200	33.1	1.9	5.41	3.38
3	300	31.0	4	11.4	5.89
4	400	28.2	6.8	19.4	4.02
5	500	26.5	8.5	24.2	6.18
		received 24 mg of copper phthalocyanine pigment with a total mass			
1	100	23.8	0.2	0.83	2.45
2	200	20.6	3.4	14.2	1.91
3	300	15.4	8.4	35.0	3.09
4	400	9.8	14.2	59.2	4.08
5	500	5.1	18.9	78.8	5.93

The results of this derivatogram show that the main mass loss of the synthesized DAPCuPc pigment occurs in the range of 150-470 °C. And in the range of 50-150°C, the mass loss of the DAPCuPc pigment is negligible.

4. Conclusion. A new type of pigment, copper diphosphate phthalocyanine (DAPCuPc), was synthesized in two ways: in the liquid phase in the presence of dimethyl sulfoxide and in the solid phase by heating the components at a high temperature. The pigment yield during synthesis in a liquid medium was 93%, but its intensity turned out to be low, and under the conditions of synthesis in the solid phase, a high pigment intensity was achieved at its 80% yield. The physicochemical properties of the new pigment synthesized in various aggregative states are compared with those of the closest analogue, copper phthalocyanine. The high thermal stability of the new pigment was discovered and possible areas of its practical application in the national economy were proposed.

Reference

[1] Yusupov M.O., Beknazarov Kh.S., Tillaev A., Dzhalilov A.T. Research of a New Pigment Based on Copper Phthalocyanin in Paint Coating Materials// International Journal of Advanced Science and Technology Vol. 29, No.03, (2020), pp.2244-2254

[2] Yusupov M.O., Beknazarov Kh.S., Tillaev A., Dzhalilov A.T. Research of a New Pigment Based on Copper Phthalocyanin in Paint Coating Materials// International Journal of Advanced Science and Technology Vol. 29, No.03, (2020), pp.2244-2254

[3] . Robiddinova, M. S., Yusupov, M. O., & Sherkuziev, D. S. Investigation of Phthalocyanine Diamidophosphate-Cobalt by Thermal Analysis.

[4] Yusupov M.O., & Ismailova, G. I. (2021). Physical Chemical Properties of Nitrogen and Phosphore Protector Cobalt Phthalocyanine (DAPCoPc) Pigment. *NVEO-NATURAL VOLATILES & ESSENTIAL OILS Journal| NVEO*, 10654-10660.

[5] Wöhrle D., Schnurpfeil G., Makarov S. G., Kazarin A., Suvorova O. N. Practical applications of phthalocyanines – from dyes and pigments to materials for optical, electronic and photo-electronic devices // Макрогетероциклы. 2012. № 5 (3). C. 191-202.

[6] Dini D., Hanack M. Physical properties of phthalocyanine-based materials // The porphyrin handbook. Netherlands: Elsevier Science, eds.: Kadish K. M., Smith K. M., Guilard R., 2003. V. 17. Ch. 107. P. 1-36.

[7] Красновский А. А., Роджерс М. А., Гальперн М. Г., Кинни М. Е., Лукьянец Е. А. Тушение люминесценции синглетного молекулярного кислорода фталоцианинами и нафталоцианинами // Биоорганическая химия. 1990. Т. 16. № 10. С. 1413-1418.

[8] Dini D., Calvete M. J. F., Hanack M. Nonlinear optical materials for the smart filtering of optical radiation // Chem. Rev. 2016. V. 116. P. 13043-13233.Herbst W., Hunger K. Industrial organic pigments: production, properties, applications. Weinheim: Wiley-VCH, 2004. 672 p.

[9] Ostroverkhova O. Organic optoelectronic materials: mechanisms and applications // Chem. Rev. 2016. V. 116. P. 13279-13412.

[10] Zhang X.-F., Xi Q., Zhao J. Fluorescent and triplet state photoactive J-type phthalocyanine nano assemblies: controlled formation and photosensitizing properties // J. Mater. Chem. 2010. V. 20 (32). P. 6726-6733.

[11] Leznoff C. C. Phthalocyanines, properties and application. New York: VCH, eds.: Leznoff C. C., Lever A. B. P. 1996. V. 4. 536 p.

[12] Smith H. M. High performance pigments. Weinheim: Wiley-VCH, 2002. 434 p.

[13] Sakamoto K., Ohno-Okumura E. Syntheses and Functional Properties of Phthalocyanines // Materials. 2009. V. 2. P. 1127-1179.

TESTING NEW ACTIVATED COALS AU-T AND AU-K FROM LOCAL RAW MATERIALS WHEN FILTRATION OF THE WASTE MDEA AT GAZLIN GAS PROCESSING PLANT

ORIPOVA LOBAR

Assistant of Karshi Engineering and Economic Institute
E-mail: oripovalobar@gmail.com

XAYITOV RUSLAN

Professor of the Bukhara Institute of Engineering and Technology
E-mail: leo-bexa@mail.ru, phone.: (+99891) 776-75-00

XUDAYBERDIEV ABDUSALOM

Professor of the Namangan Institute of Engineering and Technology
E-mail: jarayon@mail.ru, phone.: (+99899) 117-28-57

Abstract:

Background of the problem. At present, the production of activated carbons (AC) is steadily growing, and the areas of their industrial application are continuously expanding. There are four main gas processing plants in Uzbekistan, where spent amine solutions, such as diethanolamine (DEA) and methyldiethanolamine (MDEA), are filtered using activated carbons of the AG-3, HX-30, Chemveron grades at natural gas amine purification plants from acidic components. etc. The latter are of foreign origin and are imported for currencies.

Objective. In this work, the goal was to test new activated carbons AU-T and AU-K from local raw materials during filtration of spent MDEA.

Method. To obtain samples of activated carbons, carbonization of mulberry and maple wood was carried out in a laboratory tubular reactor with electric heating without air access, and the obtained carbonizates were activated with water vapor for 4–6 hours. To test the obtained samples of activated carbons during the filtration of the spent MDEA solution, as well as the analysis of the physicochemical and technical properties of the purified solution at the Gazlinsky gas processing plant (GPP), analysis methods were applied in accordance with State standards and factory regulations.

Scientific novelty. New samples of activated carbons based on mulberry (AU-T) and maple (AU-K) showed the best results in terms of adsorption properties and cleaning abilities when compared with the characteristics of factory-made, imported activated carbon grade AG-3 (Russia).

Received data. Carbonization of mulberry and maple wood was carried out in the temperature range of 300÷500°C in a reactor placed in an electric furnace with controlled heating. The resulting carbonizates are activated with water vapor for 4÷6 hours at temperatures of 700÷800 °C. After the activation process, the physicochemical and adsorption properties of the obtained samples of activated carbon were determined: bulk density - 377÷187 g/dm3, iodine activity - 30.2÷50.6%, ash content - 8.45÷9.67%, adsorption benzene activity - 1.45÷2.11 g/100 g.

After filtering the spent (saturated) and regenerated MDEA solution with activated carbons AU-T and AU-K, the physicochemical and technical characteristics of the purified solution were determined and the following results were obtained: solution concentration (%) - 26.7 ÷ 34.0, amount H_2S (mol / mol) - 0.02 ÷ 0.04, the amount of CO_2, (mol / mol) - 0.01 ÷ 0.27, pH - 9.35 ÷ 10.41, the amount of minerals (mg / l) - 6373 ÷ 7942, density, (kg/m3) - 1029÷1058.

Conclusion. New types of activated carbons were obtained from mulberry and maple wood; activated carbons AU-T and AU-K showed the best results in terms of adsorption properties and cleaning abilities when compared with the characteristics of factory-made, imported activated carbon of the AG-3 brand.

Keywords: foaming, foaming agents, methyldiethanolamine, filtration, activated carbon, mulberry, maple, carbonize, activator, steam generator, regeneration.

Introduction. In recent years, the production of natural gas and gas condensate has been intensively increasing in Uzbekistan. At gas processing plants of the republic, the absorption method of purification using various amine solutions, such as diethanolamine (DEA) and

methyldiethanolamine (MDEA) [1-3], is widely used to purify natural gas from its acidic components.

During the operation of alkanolamines, problems associated with their foaming are often observed [4–7]. Such problems were observed at all gas processing plants of the republic, where several thousand tons of used and obsolete alkanolamines were accumulated. It should be taken into account that these alkanolamines are not produced in the Republic. According to JSC Uzbekneftegaz, 312 tons of DEA and 3,522 tons of MDEA were imported for natural gas purification in 2021, worth 1,780 and 1,950 US dollars per ton, respectively [8,9].

To regenerate and prevent foaming of used alkanolamine solutions, they are purified by adsorption using activated carbon [10–12]. Activated carbons are used for adsorption treatment of regenerated amine solutions at natural gas amine purification plants from acidic components of the gas processing plant of the republic: grades AG-3 (Russia), HX-30 (China) and Chemveron. The demand for these coals in Uzbekistan is about 300 tons/year. These activated carbons are also not produced in the republic and are imported at a price of 2500÷3000 US dollars per ton. Along with this, cotton is grown annually on the territory of Uzbekistan, as a result of which large-tonnage waste is formed - cotton stalk. In addition, most of the territory of the republic is occupied by sowing fields, where mulberry, poplar, maple and other trees can be grown on the outskirts of these fields, which can serve as a good raw material for the production of activated carbon [13-17].

In this work, the goal was to obtain activated carbon samples from mulberry and maple wood and test them during filtration of spent MDEA at the Gazlinsky GPP.

Methods and materials. The process of carbonization of mulberry and maple wood was carried out in a laboratory tubular reactor with a capacity of 0.25 m3 with electric heating without air access (figure) [18–20]. Fractions 0.2–5.0 mm were processed and dried at 110°C for an hour. After loading the dried granules, the upper part of the reactor was hermetically sealed, and the lower part had a tubular outlet for the removal of resinous and gaseous products of thermal pyrolysis.

The carbonization process was carried out at 300–500°C. The process temperature was controlled using a thermocouple located in the middle part of the reactor. The rate of temperature rise was 7–10 °C per minute.
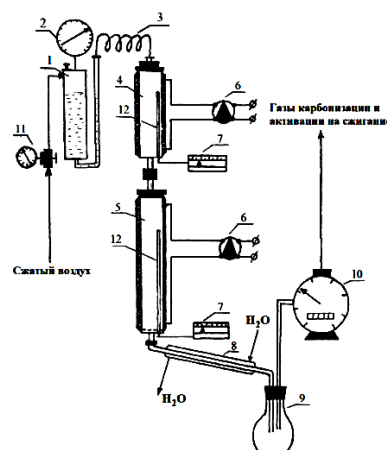

Figure 1. Laboratory plant for the production of activated carbons from organic raw materials

1 - water tank; 2 - pressure gauge (exemplary); 3 - copper capillary; 4 - steam generator; 5 - carbonization and activation furnace; 6 - lators; 7 - millivoltmeters; 8 - refrigerator; 9 - receiver; 10 - gas meter; 11 - pressure stabilizer; 12 - thermocouple pocket

Upon reaching the required temperature of the experiment, the sample was kept in the reactor for 1–2 h, and then cooled to room temperature. The released gaseous products of pyrolysis were removed from the reactor through a gas outlet tube and sent to a cooled condenser to condense water vapor and resins.

The process of carbonizate activation was carried out in the same reactor (figure). To carry out activation, carbonized granules were loaded into a tubular reactor, which was purged with a stream of nitrogen gas for 15 min to remove oxygen from the reaction zone. The upper flange of the reactor is equipped with a branch pipe for the inlet of superheated water vapor, and the lower one has a branch pipe for the removal of the vapor-gas mixture. The superheated steam required for activation was obtained in a steam generator. The flow rate of water vapor for activation was controlled by the amount of water entering the steam generator by changing the rate of its outflow in the capillary depending on the pressure above the water created in the dosing tank with the help of nitrogen. Температуру активации регулировали нагревом реактора и парогенератора.

Нагрев образца проводили до конечной температуры активации, которая находилась в интервале 700÷800 °C. The activation temperature was controlled by heating the reactor and steam generator. The sample was heated to the final activation temperature, which was in the range of 700–800°C. When the set temperature was reached, water vapor was supplied to the reactor from the generator for 4–6 h. thermal conductivity detector.

After heat treatment of the obtained activated carbon, it was left to cool to room temperature without air access.

To test the obtained samples of activated carbons during the filtration of the spent MDEA solution, as well as to analyze the physicochemical and technical properties of the purified solution at the Gazlinsky GPP, analysis methods were applied in accordance with the State Standards and the technological regulations of the plant.

Results and discussion. When we obtained samples of activated carbon by carbonization of mulberry and maple wood with subsequent steam activation of coal, the following results were obtained (see Tables 1 and 2).

Table 1

Conditions and results of carbonization of mulberry and maple wood

Samples	Process of temperature, °C	Raw material weight, g	Carbonizate weight, r	Bulk density, g/dm^3	Ash content, %	Adsorption activity according to C_6H_6, g/100 g
	300	1000	613	524	4,8	0,24
AU-T	400	1000	521	507	5,2	0,46
	500	1000	405	482	6,1	0,52
	300	1000	576	516	4,2	0,87
AU-К	400	1000	453	463	4,5	1,18
	500	1000	345	368	5,3	1,35

The obtained carbonizates of wood raw materials are activated by water vapor. Conditions and results of activation are given in the following table. 2.

Table 2

Conditions and results of steam activation of mulberry and maple wood carbonizates

Samples	Temperature, °C	holding time, h.	Degree of burning, %	Bulk density, g/dm^3	Iodine activity, %	Ash content, %	Adsorption activity according to C_6H_6, g/100 g
АУ-Т	700	6	35	377	30,2	8,45	1,45
	800	4	52	270	48,5	10,51	1,87
АУ-К	700	6	43	258	36,2	8,26	1,65
	800	4	58	187	50,6	9,67	2,11

The obtained experimental results are given in table. 1 allowed us to state that the satisfactory conditions for the carbonization of mulberry and maple wood are the duration of 1 hour at 500 °C.

Based on the data obtained (Table 2), it was stated that the rational conditions for the activation of mulberry and maple wood carbonizates are: temperature 800 °C, process duration 4 hours.

Some characteristics of the obtained samples of activated carbon AU-T and AU-K are compared with the known industrial activated carbon of grade AG-3 (Table 3).

Table 3

Some comparative characteristics of activated carbons

The name of indicators	Activated carbons		
	AG-3 (control)	AU-T	AU-K
Bulk density, g/dm^3	450	270	187
Adsorption activity according to C_6H_6, g/100 g	1,23	1,87	2,11
Iodine activity, %	43,0	48,5	50,6
crush strength, kg/ granules	0,8	1,0	0,9
Ash content, %	14÷16	8÷10	8÷9

Based on the data presented in Table 3, it is proved that activated carbon samples obtained from local raw materials - AU-T mulberry wood and AU-K maple wood, are superior in adsorption properties to activated carbon AG-3 imported from the Russian Federation, which is currently time is used in the existing gas processing plants of our republic. The conducted studies allow us to recommend these samples for filtration of amino alcohols (MEA, DEA, MDEA) used during natural gas purification.

The obtained new samples of activated carbon AU-T and AU-K were tested during filtration of the spent (saturated) and regenerated MDEA solution at the Gazlinsky GPP. After filtration, the physicochemical and technical characteristics of the purified solution were determined. The results of the analysis are shown in the following tables 4 and 5.

Table 4

Results of analysis of saturated MDEA solution

№	Samples	Concentration, %	Quantity H_2S, mole/mole	Quantity CO_2, mole/mole	pH	Quantity of minerals mg/l	Density
1	Насыщенный раствор	33,9	0,06	0,36	9,30	6483	1,055
			Results after filtering				
2	АГ-3	31,2	0,03	0,25	9,32	6465	1,057
3	АУ-Т	32,6	0,04	0,26	9,35	6373	1,058
4	АУ-К	34,0	0,04	0,27	9,40	6427	1,058

Table 5

Results of the analysis of the regenerated MDEA solution

№	Samples	Concentration, %	Quantity H_2S, mole/mole	Quantity CO_2, mole/mole	pH	Quantity of minerals mg/l	Density
1	Regenerated solution	26,4	0,006	0,35	9,36	7846	1,034
			Results after filtering				
2	AG-3	26,7	0,003	0,01	10,26	7735	1,032
3	AU-T	26,8	0,004	0,02	10,36	7243	1,029
4	AU-К	26,7	0,002	0,01	10,41	7942	1,034

As can be seen from the test results presented in tables 4 and 5, after filtering the saturated and regenerated MDEA solution using activated carbons AU-T and AU-K, the content of foaming and corrosive components in the solution decreased in the following order: H2S - from 0.006 to 0.002 mol/mol; CO2 - from 0.35 to 0.01 mol/mol; minerals - from 7846 to 7243 mg / l. The above results show that the pH of the solution after filtration increased from 9.36 to 10.41, indicating a decrease in the concentration of foaming components.

Conclusion. Comparison of our own experimental data with the literature data showed that the samples of activated carbon obtained by us from local raw materials AU-T and AU-K in terms of adsorption activity and other physical and chemical parameters are at the level of the well-known activated carbon AG-3, which is one of the highest quality coals. world industrial production. According to the test results, it was proved that the filterability of these activated carbons exceeds the filterability of activated carbon of the AG-3 type imported from the Russian Federation, which is used to filter the MDEA solution at the Gazlinsky GPP.

Thus, the performed studies show the feasibility of processing mulberry and maple wood into carbon adsorbents for various purposes.

References

1. Oripova L.N., Khayitov R.R. Obtaining activated carbon from wood and stone raw materials // Universum: technical sciences: electron. scientific magazine - 2021. - No. 9(90). - pp. 14-17.

2. Bakhramov N.I., Teshaeva M.Sh., Khayitov R.R. Development of a method for obtaining activated carbon from local raw materials for the adsorption purification of spent amine solutions // "Science and Education" scientific journal. - Volume 3. - Issue 4. 2022. - R. 377-383.

3. Akhadov A.A., Murodov M.N., Khayitov R.R., Oripova L.N., Toshkuziev T.M. Determination of the structural and sorption properties of activated carbon obtained from the shell of apricot seeds // "Science and Education" scientific journal. - 2021. - Vol. 2. - No. 1. - S. 52-58.

4. Chudievich D.A. Improving the technology of defoaming at the installations of amine desulphurization of hydrocarbon gases: Abstract of the thesis. dis. Ph.D. - Astrakhan, 2000. - 25 p.

5. Agaev G.A. Foam Control in the Process of Amine Treatment of Natural Gas. - M.: VNIIEgazprom. 1979. - 33 p.

6. Strizhov I.N. Gas production. - Moscow-Izhevsk: Institute for Computer Research, 2003. - 376 p.

7. RF patent No. 2198722. Method for preventing foaming of amine solutions / Lykova L.F., Pestovnikov O.D., Prokhorov E.M., Tarakanov G.V., Chudievich D.A. Appl. 06/08/2001, Published. 02/20/2003.

8. Oripova L.N., Khayitov R.R. Research of foaming characteristics of DEA and MEA // International Journal of Advanced Research in Science, Engineering and Technology, 2022. - Vol. 9. - Issue 5. - P. 19328-19333.

9. Khayitov R.R. Development of technology for obtaining activated carbon from local raw materials for the purification of waste amine solutions: Abstract of the thesis. d.t.s. - Tashkent, 2019. - 67 p.

10. Kienle H., Bader E. Activated carbons and their industrial application (translated from German). - L .: Chemistry, 1984. - C. 215.

11. Weltia N., Bondar-Kunzea E., Singerb G., Tritthartd M., Zechmeister-Boltensterne S., Heina T., Pinay G. Large-scale controls on potential respiration and denitrification in riverinefloodplains // ELSEVIER. - 2012, Marth. - P. 73-84.

12. Ansaa E.D.O., Lubberdingb H.J., Ampofoa J.A., Amegbea G.B., Gijzenb H.J. Attachment of faecal coliform and macro-invertebrate activity in the removal of faecal coliform in domestic wastewater treatment pond systems // ELSEVIER. - 2012, Marth. - P. 35-41.

13. Salimov I.R., Murodova Yu.M., Murodov M.N., Tilloev L.I., Khayitov R.R. Determination of the optimal regime for obtaining activated carbon from the shell of fruit stones for the purification of alkanolamines // Universum: Technical sciences: electron. scientific magazine - Moscow (RF), 2020. - No. 7 (76). - S. 77-81.

14. Khayitov R.R., Shermatov B.E., Eshonkulov U.U., Narmetova G.R. Carbonization of apricot kernels and steam activation of carbonizate to obtain activated carbon // Uzbek chemical journal. - Tashkent, 2017. - No. 3. - S. 65-694.

15. Khayitov R.R., Eshonkulov U.U., Narmetova G.R. Activated carbons from local raw materials for the regeneration of alkanolamines for natural gas purification instead of sorbent AG-3 // Scientific and technical journal: World of petroleum products. Bulletin of oil companies. - Moscow (RF), 2016. - No. 11. - S. 43-46.

16. Khayitov R., Narmetova G. Production of activated coal from the pits of apricots and peach for the adsorption purification of the waste Diethanolamine // Austrian Journal of Technical and Natural Sciences «East West» Association for Advanced Studies and Higher Education GmbH. - Vienna, 2016. - № 7-8. - P. 67-706.

17. Khayitov R.R., Naubeev T.Kh., Sapashov I.Ya., Khaidarov B.A., Abdikamolov D.Kh. Determination of physicochemical and adsorption characteristics of new activated carbon from apricot seeds // Universum: Technical sciences: electron. scientific magazine - Moscow (RF), 2017. - No. 2 (35).

18. Khayitov R., Narmetova G. Regeneration of alkanolamines used in natural gas purification // Journal of Chemical Technology and Metallurgy. - Bulgaria, 2016. - V.51. -

№ 3. - P. 12-16.

19. Khayitov R., Narmetova G., Shermatov B. Regeneration of activated carbon used in adsorption purification of alkanolamines // Austrian Journal of Technical and Natural Sciences «East West» Association for Advanced Studies and Higher Education GmbH. - Vienna, 2016. - № 7-8. - P. 75-77.

20. Shermatov B.E. Development of technology for obtaining recuperative and clarifying sorbents from cotton lignin: Cand. for the scientific degree of Cand. those. Sciences. - T .: Uzbek Research Institute of Chemical Technology and Catalysis, 1994. - 117 p.

UDC 101.67

BASED ON ENERGY EFFICIENT PARAMETERS OF FRUIT DRYING CHAMBER DEVICES FOR SMALL ENTERPRISES

KURBANOV NE'MATILLA

PhD of Namangan Institute of Engineering and Technology
E-mail: nematilla68@mail.ru, phone: (+99894) 275-69-39

ROZIKOVA DILSHODA

PhD of the Namangan Institute of Engineering and Technology
E-mail: dilshoda@mail.ru, phone: (+99893) 677-41-35

Abstract:

Objective. Identifying the biological characteristics of the date fruit set as tasks in the organization of the technology of artificial drying of date fruit and skin; Analysis of widely used varieties in Uzbekistan; determining the main technological processes; biological properties and determination of the composition of the finished powder and the secondary filler. Expanding the assortment of agricultural products and providing the population with environmentally friendly food products is becoming one of the urgent issues. Development of an energy-efficient improved device that dries agricultural products in sufficient quantity with low consumption costs, as well as justification of its main parameters, efficient use of energy is directed to the main tasks. The drying chamber consists of two modules (drums) moving against the flow of hot air, and in the process of drying raw materials, it makes efficient use of time and leads to the drying of quality products in an energy-efficient way.

Methods. Thus, factors that increase the speed of the drying process include:
- process temperature raise _
- on the material being dried in the void the pressure reduction ;
- keep the heat conductor moist reduce _
- heat conductor on the material speed increase _
- process during the material mixing _

Results. The dry fruit version of dates is higher in calories than the fresh fruit. The high calorie content of dates gives a person great energy throughout the day. Dates are also packed with many vitamins and other nutrients that can be very beneficial for your health. Dates are rich in fiber and carbohydrates.

Conclusion. Diabetes is treated using synthetic drugs in combination with several drugs and supplements such as insulin. The substances contained in the date and its skin cells have the property of increasing the production of insulin, as well as reducing the absorption of glucose from the intestine. It is advisable to eat dates fresh, dried, or after drying the fruit skin and turning it into a powder, as an additive to food.

Keywords: Pharmacological properties, date skin, compounds, flavonoids, calories, pharmacological properties.

Introduction. Today, expanding the assortment of agricultural products and providing the population with environmentally friendly food products is becoming one of the urgent issues. Development of an energy-efficient

improved device that dries agricultural products in sufficient quantity with low consumption costs, as well as justification of its main parameters, efficient use of energy is directed to the main tasks. The drying chamber consists of two modules (drums) moving against the flow of hot air, and in the process of drying raw materials, it makes efficient use of time and leads to the drying of quality products in an energy-efficient way. (Figure 1)

Methods.
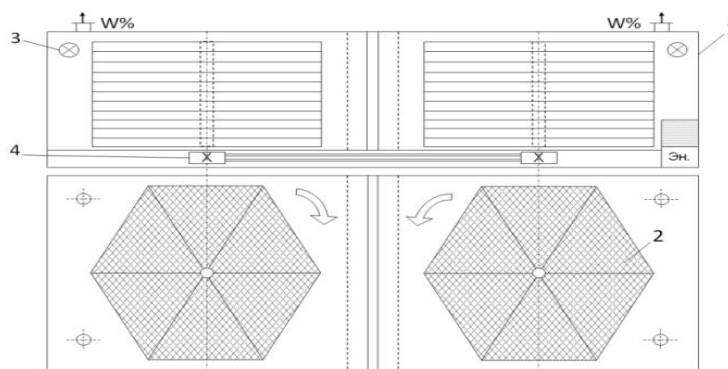
1-body, 2-moving drums, 3-heater, 4-extension,

Thus, factors that increase the speed of the drying process include:
- process temperature raise _
- on the material being dried in the void the pressure reduction ;
- keep the heat conductor moist reduce _
- heat conductor on the material speed increase _
- process during the material mixing _

In the process of drilling parameters : technological , kinematic and constructional be the process heat conductor and devices in acceleration parameters as follows set we get :

G_c - mass of material being dried , kg/ h ;

s_s - specific heat capacity of dried material , kJ (k ·K);

s_T - of the transport device specific heat capacity , kJ /(kg ·K);

t_n - of the material until dry has been temperature , °C;

s_v - of water specific heat capacity , kJ /(kg ·K);

t_k - of the material from dried later temperature . °C;

t_{tn} , t_{tk} - transport device to the dryer from the entrance from the former and from it next temperatures , °C;

I_0 - to the dryer entering the air comparison enthalpy , kJ /kg;

I_1 - in the heater being heated the air comparison enthalpy , kJ /kg;

I_2 - from the dryer coming out the air comparison enthalpy , kJ /kg;

Q_p - surroundings to the environment of heat loss , kJ /kg.

Taken away research as a result dryer not be built main parameters dependency identified .
- do not build size , m
- drum diameter , m
-drum rolls rpm _
- of the walls thickness , mm
- drying size, m.
- number of pads , pcs

- rotation speed , rpm _
- general mass , t
- consumption to be done power , kW
- the distance between the pads, m

2. Slivani from drying from before and after next condition
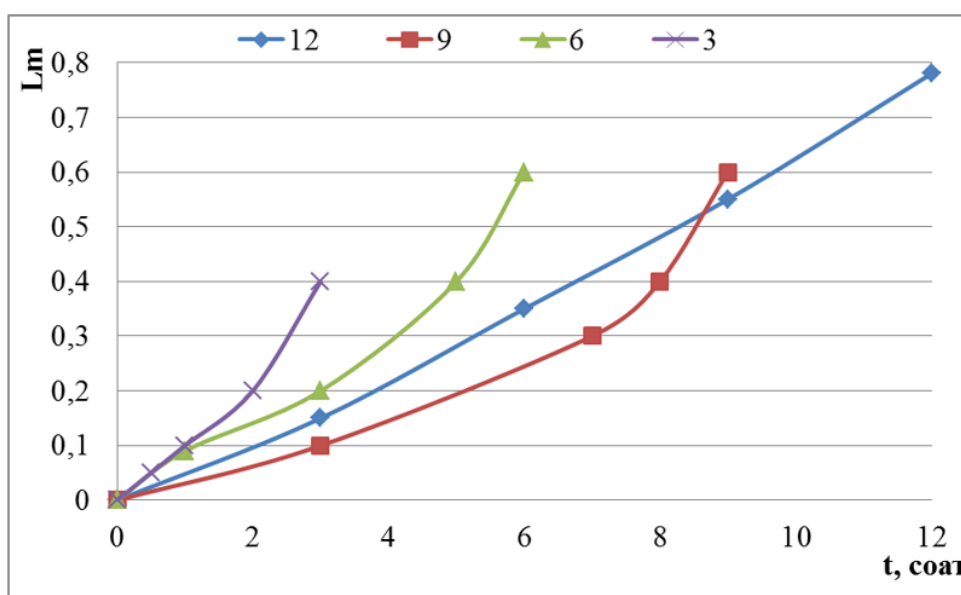
Figure 3. Variation of the speed of the drum during the drying process. The change in the rotation of the drum to the heat flow of air when r=0.80 m

Results. As a result of the conducted theoretical and practical work, the energy-efficient parameters of the fruit drying chamber devices, in accordance with the movement speed of the leading and driven drum, when using materials from the experimental apparatus of the hot air flow in the opposite direction, the layer is found in a dense, fountain-like state, that is, the process accelerates. The drying agent is heated by steam, hot water, fire heaters or electric current. Different options of the drying process are widely used: removing the used drying agent from the dryer, reusing the drying agent, heating the drying agent between the drying chambers, dividing the drying agent into the drying chambers. , additional heating of the drying agent in the drying chamber, use of a variable heat field (sequential exchange of

hot and cold air to the material layer) finds acceptable solutions in the main parameters of the process.

According to the design of the proposed improved dryer, a simple and moving drum is calculated based on the number of sections and the number of revolutions.

The dry fruit version of dates is higher in calories than the fresh fruit. The high calorie content of dates gives a person great energy throughout the day. Dates are also packed with many vitamins and other nutrients that can be very beneficial for your health. Dates are rich in fiber and carbohydrates.

Tabl.1

Nutritional value of 100 grams of dates:

Total energy value	270-310 kkal
Protein content	5-6 g
Total fat content	0,4 g7
Sodium content	2 mg
Potassium content	656 mg
Carbohydrates (dietary fibers and sugars)	75 g

As can be seen from the table, dates have a very high energy content, 100 g of dates contain 310 kcal of energy. While most of this energy is in the form of sugar (such as fructose and glucose), it is high in fiber and low on the glycemic index. This means that eating 2-3 dates at a time is a safe source of low-fat energy, even for diabetics. This is one of the best benefits of dates and helps in weight management and blood sugar regulation. Due to the high content of dietary fibers in the date fruit, when it is consumed, intestinal activity improves and helps with regular bowel movements. It was also noted that when dates are regularly consumed, the concentration of ammonia in feces is significantly reduced. Therefore, it is safe to say that dates make a significant contribution to the overall nutritional system and overall health. Antioxidants are basically compounds that destroy dangerous free radicals that cause oxidation process and cause great damage to human cells. Oxidation can be very dangerous because it can cause significant damage to the structural and genetic integrity of cells. Date meat and skin cells have a high concentration of antioxidants. Especially dried and powdered date peel contains a lot of antioxidants. Dried and powdered dates contain carotenoids, flavonoids and phenolic acid. Caratenoids are very important for the well-being of the eyes. They also help improve heart health. Flavonoids, on the other hand, are a type of antioxidants that are known to have anti-inflammatory properties and help reduce the effects of chronic diseases such as diabetes. Flavonoids are also beneficial for brain function and have been shown to reduce the risk of degenerative brain diseases such as Alzheimer's.

There is also evidence that flavonoids may help reduce the risk of certain types of cancer. Phenolic acid is also a type of antioxidant and is mainly known for its anti-inflammatory properties. It is useful in reducing the risk of heart disease and some types of cancer. Inflammatory cytokines like interleukin can be very dangerous for your brain. An increase in IL-6 (Interleukin 6) causes the development of neurodegenerative diseases such as Alzheimer's disease. The presence of inflammatory markers is never a good sign for nerve health, and therefore extreme caution is required in this situation. Regular use of dates has been found to be beneficial in reducing IL-6 levels, thus helping to reduce the risk of developing degenerative brain diseases such as Alzheimer's. . Diabetes is one of the most common diseases in the world.

Discussions. Diabetes is treated using synthetic drugs in combination with

110

several drugs and supplements such as insulin. The substances contained in the date and its skin cells have the property of increasing the production of insulin, as well as reducing the absorption of glucose from the intestine. It is advisable to eat dates fresh, dried, or after drying the fruit skin and turning it into a powder, as an additive to food. Figure 4 in the obtained experimental results it can be seen that analytical experimental results were based on some parameters in the process of extracting moisture.

Figure 4. The time and temperature of the drying process are gradually increased

Tabl.2

Amount of time taken for drying Temperature taken for drying	Amount of time taken for drying Temperature taken for drying
1 hour; 30 minutes at 250C	1 hour; 30 minutes at 250C
2 hours at 300C	2 hours at 300C
3 hours at 500C	3 hours at 500C
4 hours at 650C	4 hours at 650C
5 hours at 700C	5 hours at 700C

Conclusion. Based on the experimental research, the theoretical calculations were tested to determine the main parameters of the proposed drying device.

References
1. N. R. Yusupbekov, H. S. Nurmukhammedov, S.G. Zakirov Chemical technology main processes and devices. - T.; "East", 2003.-644b.
2. N. R. Yusupbekov, H. S. Nurmukhammedov, P.R. Ismatullaev, S.G. Zakirov, U. V. Mannonov. Calculation and design of the main processes and devices of the chemical and food industries. - Tashkent, TashKTI, 2000. - 231 pages.
3. N. R. Yusupbekov, H. S. Nurmukhammedov, P.R Ismatullaev Calculations and problems in the science of basic processes and devices of the chemical and food industries. - Tashkent, TashKTI, 1999. – 351 pages.
4. Salimov. Z. Basic processes and devices of chemical technology.: Textbook for students of higher educational institutions. T.1.-T.: Uzbekistan, 1994.-366 p.
5. Salimov.Z. Basic processes and devices of chemical technology. T.2. Metabolism processes: a textbook for higher educational institutions.-T.: Uzbekistan, 1995.-238 p.

6. Panfilov.V.A., Artikov A.A., Khudayberdiev A.A., Khamdamov A.A., Kurbanov N.M., Technological lines for the production of food products Ukuv kullanma, Namangan -2021

7. Р.Орипов, И. Сулайманов "Қишлоқ хўжалик махсулотларини сақлаш ва қайта ишлаш технологияси". Тошкент, 1991.

8.Е.П.Широков "Технология хранения и переработки плодов и овошей" М.: "Колос".1994г.-234стр.

9. В.В.Момот, В.В.Балабанов. Механизация процессов хранения и переработки плодов и овошей: Справочник . М.: 1996г.-272 ст.

10.Р.Ж.Жўраев, М.М.Адилов, З.А.Абдуқаюмов "Қишлоқ хўжалик махсулотларини сақлаш ва қайта ишлаш технологияси". Тошкент, 1999йил.

11.3. С. Искандаров. Научные основы регулируемого теплового процесса сушки пищевых продлуктов высокой влажности. Ташкент: Фан – 1995. 185 с.

12.Г. Г. Умаров и др. Гелиосушка сельхозпродуктов. Ташкент: Фан – 1994. 152 с.

13.Б.П.Шаймарданов, К.Э.Усмонов. Қуритилган махсулот сифати. Ўзбекистон қишлоқ хўжалиги журнали. №7 2005. 36 б.

14.Салихов Суръят Акрамович - биология фанлари доктори, профессор. "Мутахассисликка кприш". Укув кулланма. Т.: ТДИУ, 2015 Пил, 263 бет.

15.Б.Т. Салимов, М.С. Юсупов, Ўзбекистонда мева-сабзавот маҳсулотлари етиштириш ва экспорт қилишни давлат томонидан қўллаб-қувватлаш йўналишлари. *"Иқтисодиёт ва инновацион технологиялар" илмий электрон журнали. № 4, июль-август, 2015 йил.*

16. Касаткин А.Г. Основные процессы и аппараты химической технолигии. М.: Химия, 1973. (616 с.) 750 с.

17. Патент РФ №2051588, М. кл. А23В 7/02.

18. Н.Р.Юсупбеков, Х.С.Нурмухаммедов, С.Г.Зокиров. Кимёвий технология асосий жараён ва қурилмалари.- Т.: "Фан ва технология", 2015, (585 б.) 848 б.

19. О.Мансуров, Д. Игамбердиева, А.Хамдамов. Системный анализ процесса сушки сельхозпродуктов. "Universum: Технические науки", 2021й, ноябрь. № 11(92)

20. Мелибоев М.Ф., Маматов Ш.М., Эргашев О.К. Разработка комбиниро-ванного метода сублимационной и диэлектрической сушки // Universum: технические науки. – Москва-2022. - №5 (98). – С.5-8 (02.00.00.№1).

21. Мелибоев М.Ф., Маматов Ш.М., Эргашев О.К. Энергопотребление и экономические показатели при сублимационной и микроволновой сублимационной сушке слив // Universum: технические науки. – Москва-2022. - №5 (98). – С.9-12 (02.00.00.№1).

22. M.Meliboyev. Sublimatsion va dielektrik quritish jarayonlarini kombinatsion usulini ishlab chiqish// Fan va texnologiyalar taraqqiyoti ilmiy-texnikaviy jurnali. (BuxMTI)-2021.-№5.- 182-187b. (02.00.00., №14)

BASIC METHODS AND TECHNOLOGICAL SCHEMES FOR OBTAINING VEGETABLE OILS

XAKIMOV SHAVKAT

Associate professor of Namangan institute of engineering and technology
E-mail: sh.xakimov@mail.ru, phone.: (+99893) 923-00-41

KOMOLIDDINOV MUXAMMADALI

Master student of Namangan institute of engineering and technology

Abstract:

Objective. In world practice, there are two main ways to obtain vegetable oils, which are fundamentally different from each other. These, mechanical compression of the oil, are called the pressing method, and melt the oil using a light volatile organic solvent, or extraction method. These binary methods can be used separately independently or together in a specific order. When used last year, this method is called forpressing-extraction. Regardless of which method is used, each method is carried out according to a specific technological scheme.Technological scheme is that of technological processes that are logically inextricably linked with each other, performed in the necessary order.

Methods. Agrotechnical indicators of the device for extracting oil from seeds of oil crops OST 79.10.2-74 "zernoochistitelnie mashini, aggregate zernoochistitel nosushilnie complex. Software method I ispitaniy", OST en 63.01-99 " ispitaniya selskoxozyaystvennoy technical. Kombayni zernouborochnie. Software method I according to" ispitaniy, while energy indicators Tst 63.03:2001 "Ispitaniya selskohozyaystvennoy technical. Method energeticheskoy otsenki mashin " determined according to.

Results. The research of the technological system of storage of fatty raw materials and the quality of oil products produced from it is a scientific novelty of this work.

Conclusion. it is worth noting that the processes of storage of fatty raw materials have been studied. The advantages of oil extraction methods from fatty raw materials, oil output, the amount of oil to be taken into account and the amount of oils in Kunjara and Shrot, the method of obtaining high oil was selected, studied.

Keywords: cotton seeds, vegetable oils, extraction, forpressing-extraction, oilseeds, rafination, kernels, pressing.

Introduction. As a result of the new Agrarian Policy in the Republic, unilateral development in agriculture was stopped. Reforms in agriculture were carried out to develop the oil and oil industry and expand the arable land, increase productivity, apply new oil crops to the production of varieties of sunflower, peanut, maxsar, soybean and other oil crops, develop their agrotechnics in the short term and meet the needs of the population for vegetable oils in the result of the harvest.

The oil oil industry mainly produces sunflower, seeds, peanuts, beans, flax, garchitsa and kanakunjut oil from 7-8 different raw materials. In addition to these, indov, grape seeds, various fruits danagi, hemp, copra, etc. are also processed, the amount of which is 2.5% of the total fat obtained.

On October 27, 2020, the decree of the president of the Republic of Uzbekistan No. 6094 "on amendments and additions to certain documents of the president of the Republic of Uzbekistan"was signed.

According to him, it was established that cotton technical seeds are sold to local enterprises through the exchange, regardless of the organizational and legal form. It was determined that the enterprises participating in the exchange trade have a complete technological cycle of processing cotton technical seeds (core milling, hydrothermal processing, pressing, extraction, rafination, deodorization and packaging Tsex), as well as have the appropriate hygienic conclusion and certificates of conformity for the finished products reproduced at the enterprise.

Methods. The quality indicators of oilseeds, all technological parameters

related to these processes, studying the methods of their acceptance at the enterprise, storage, cleaning, preparation for the pressing process, extraction and oil extraction, are the issues of the correct conduct of settlement work, together with which ways to eliminate them in cases where a violation of technological processes occurs. Oilseeds, storage facilities and types of it, oilseeds processing oil extraction tenchological process and oil production enterprise.

Results. When technological operations are carried out, the processed product is under various external influences. These include the influence of mechanical, thermal, moisture, solvent and chemical reagents in their place.

Processes in performing one or another technological operation can be conditionally divided into basic and approach processes. It should be noted that in most cases, the approach processes have a strong effect on the general direction and final effect of the operation. For example, when squeezing oil, mechanical and hydrodynamic (oil leakage) processes are considered the main ones, which give an impetus to the occurrence of an approach process that converts mechanical energy into thermal energy at the expense of friction force. The approach of heat separation process the protein in Kunjara enhances chemical processes such as denaturation of substances, oxidation of oil, and diffusion evaporation of moisture.

The processes performed in the technological schemes of processing oilseeds by separating the shell from the core are made up of preparatory, basic, auxiliary and additional operations. The main operations include grinding oil seeds (milling), frying, pressing and extracting oil by extraction. Preparatory operations include receiving, drying, storing oilseeds, cleaning them from impurities and separating the ust shell from the core. Auxiliary operations, on the other hand, include driving the solvent from the shrot composition to extract the oil from the mistsella, regenerating and regenerating the solvent vapors. Additional operations include primary purification of forpress or extraction black oils, obtaining phosphatide concentrate, and separation of protein substances.

Table 1

Rafinated oil indicators obtained by the Press method

| № | Name of indicators | Norms for refined oil obtained by the Press method | | | | |
| | | Desadoration-langan | | Disadorated | | |
		High Type	First variety	High Type	First variety	Second grade
1	The number of Colors is not much in the Red Unit 35 in the yellow unit 35 - 79,9 in the yellow unit	5	8	5	8	14
2	Acid number, mg KOH/g not much	0,2	0,2	0,2	0,3	0,5
3	Mass fraction of moisture and volatile substances, not more than %	0,1	0,1	0,1	0,2	0,2
4	Mass fraction of non-fat mixtures (mass precipitate),%, not more	Not available				0,05
5	Soap (quality indicator)	Not available				

6	Iodine number gJ/100g	101-116	101-116	101-116	101-116	101-116
7	Non-saponifying substances are not high in %	1,0	1,0	1,0	1,0	1,0
8	Perekis number, mmol / kg, 0,5 "O", not much	10	10	10	10	Aniqlan-maydi
9	Determination of the presence (by quality)of solvent (gasoline) in oil			Not available		

Discussion. The inextricable connection of basic, preparatory, auxiliary and additional operations forms a technological scheme.

The following technological schemes are used to obtain vegetable oils in foreign and CIS countries:

1. Schemes to be completed by the pressing method: a) one-time pressing method using Auger presses; b) two-time pressing method using Auger presses; C) three - time pressing method using Auger presses.

According to the physico - chemical indicators, the refined oil obtained by the press method must comply with the requirements of Table 1.

Depending on the quality indicators and degree of purification, oil is produced in the following types and varieties (Table 2).

Table 2

Separation of oil obtained by the Press method into varieties depending on quality indicators and degree of purification

№	Type of oil	Type	OKP code
1	Desadorated	High Type	91 41 15 61 14
2	Desadorated	First variety	91 41 15 62 14
3	Disadorated	High	91 41 15 31 14
		High	91 41 15 31 99
4	Disadorated	First	91 41 15 32 14
		First	91 41 15 32 99
5	Disadorated	Second	91 41 15 33 99

2. Schemes to be completed by the extraction method: a) double pressing and extraction at the end; b) one-time pressing and extraction at the end; C) direct extraction. According to both schemes (B) methods are the most common, while Method 2-b is called the "forpressing - extraction" scheme. More than 85% of vegetable oils produced in our republic are obtained according to the same scheme.

According to the physico - chemical indicators, the refined oil obtained by the extraction method must comply with the requirements of the table.

Table 3

Rafinated oil indicators obtained by the extraction method

№	Name of indicators	Norms for refined oil obtained by the Press method				
		Desadoration-langan		Desadoration-langan		
		High Type	High Type	High Type	High Type	High Type
1	The number of Colors is not much in the Red Unit 35 in the yellow unit 35 -79,9 in the yellow unit	5	8	5	8	14
2	Acid number, mg KOH/g not much	0,2	0,2	0,2	0,3	0,5
3	Mass fraction of moisture and volatile substances, not more than %	0,1	0,1	0,1	0,2	0,2
4	Mass fraction of non-fat mixtures (mass deposition),%, not more	Not available				0,05
5	Soap (quality indicator)	Not available				
6	Iodine number gJ/100g	101-116	101-116	101-116	101-116	101-116
7	Non-saponifying substances are not high in %	1,0	1,0	1,0	1,0	1,0
8	Perekis number, mmol / kg, 0,5 "O", not much	10	10	10	10	Not detected
9	Determination of the presence (by quality)of solvent (gasoline) in oil	Not available	The solvent residue is determined (the color of the indicator tube is painted in light brown			
10	The spark temperature o C is not less	Not available	232	232	232	-

Depending on the quality indicators and degree of purification, oil is produced in the following types and varieties (Table 4).

Conclusion. In conclusion, it is worth noting that the use of the extraction method in the extraction of oil from oil seeds in different ways made it possible to obtain the most oil from raw materials. But at the same time, the use of various solvents during extraction forces to take measures to prevent explosion and poisoning, to strictly follow the rules of technical safety, labor protection, and fire prevention. At the same time, it is possible to clearly determine the advantage of the process of extracting oil by pressing and extraction.

References

1. Руководство ВНИИЖ по технологии получения и переработки растительных масел., Л. 1975., II-IV томлар.

2. Halimova U.H., O'simlik yog'lari ishlab chiqarish texnologiyasi. - T.: "O'qituvchi", 1982.

3. Qodirov Y., Yog'-moy mahsulotlari ishlab chiqarish texnologiyasi. Kasb-hunar kollejlari uchun o'quv qo'llanma. T.: "Sharq", 2007-240 b.

4. Чертков Н.И., Луговой А.В. и др. Хранение растительных масел и жиров, М. Агропромиздат, 1989, -288 с.

5. Шербаков В.Г. Основы управления качеством продукции и технологический контроль жиров и жирозаменителей. М. 1985. -213 с.

6. Шербаков В.Г. Технология получения растительных масел. М.: Колос. 1992 г.

7. https://xs.uz/uzkr/post/bir-tonna-chigitni-qajta-ishlash-kharazhatlari-ortacha-miqdori-52-million-som-tashkil-etadi-ozyogmojsanoat-uyushmasi

SIZE-EXCLUSION CHROMATOGRAPHY OF SOME POLYSACCHARIDE DERIVATIVES FROM NATURAL SOURCES

BOIMIRZAEV AZAMAT

Professor of Namangan Institute of Engineering and Technology
E-mail: a.boymirzayev@nammti.uz

KAMOLOV ZIYOVADIN

Master student of Namangan Institute of Engineering and Technology

Abstract:

Objective. In the article molar mass and structural properties some of natural polysaccharides and their derivatives were studied by Size-exclusion chromatography.

Methods. For investigation of electrostatic and polyelectrolyte properties of natural polysaccharides Exclusion liquid chromatography method was used.

Results. Polyelectrolyte and electrostatic effects of polysaccharide derivatives in Size-exclusion chromatography were suppressed by using of aqueous eluent containing salt solution.

Conclusion. As a result of the research, it was shown that many of polysaccharides are polyelectrolytes and determination of their molar mass parameters is complicated by electrostatic effects in Size-exclusion chromatography.

Key words: polysaccharides, carboxymethyl chitosan, galactomannan, exclusion chromatography, heparin, electrostatic effects, polyelectrolytes.

Introduction. Water-soluble derivatives of polysaccharides are widely used due to a wide range of their useful and unique properties in biomedicine, pharmaceuticals, cosmetology, agriculture, and other fields. Biologically active polysaccharides from natural raw materials include chitosan, carrageenan, arabinogalactan (AG), heparin, agar, fucoidan, etc. Agar and carrageenan are obtained by extraction from red and fucoidan from brown seaweeds, and the chains of green algae polysaccharide molecules have a heterogeneous structure with sugar residues, such as glucuronoxylorgamannans, glucuronoxylo-raw materials include chitosan, carrageenan, arabinogalactan (AG), heparin, agar, fucoidan, etc. Agar and carrageenan are obtained by extraction from red and fucoidan from brown seaweeds, and the chains of green algae polysaccharide molecules have a heterogeneous structure with sugar residues, such as glucuronoxylorgamannans, glucuronoxylo-rhamnogalactans, and xyloarabino-galactans [1, 2]. They are considered potential biologically active substances and have immunomodulatory, antitumor, antiviral, and antibacterial properties [3]. The most widely used anticoagulant drug in modern medical practice is the natural glycosaminoglycan heparin, however, the use of heparin causes some side effects, such as bleeding, and heparin-induced thrombocytopenia. The anticoagulant activity of sulfated polysaccharides

depends on the method of sulfation, which affects the degree of sulfation, the nature, and location of sulfate groups, molecular weight, etc. Many sulfated polysaccharides have a variety of biological activities, including anticoagulant, antithrombotic, antiviral, and antibacterial. [4-8]. Plant polysaccharides such as pullulan, galactan, galactomannan, and fucoidan sulfates have anticoagulant activity [9–13]. This article discusses the physicochemical and molecular weight characteristics of polysaccharides and their derivatives determined by the method of Size Exclusion Chromatography (SEC).

It is known from a few literature sources [10, 13] that sulfated derivatives of AG have hypolipidemic and anticoagulant activity. In the laboratory of natural synthons and ligands of the Irkutsk Institute of Chemistry, named after A.E. Favorsky Siberian Branch of the Russian Academy of Sciences, sulfated AG was obtained in the form of a potassium salt by sulfating AG with the SO3-dimethylformamide complex in dimethyl sulfoxide [11, 12]. In preliminary preclinical studies, the drug proved to be a promising lipid-lowering agent with a pronounced anticoagulant effect [14–17]. A relatively small number of works [18, 22] have been devoted to the study and determination of the molar mass of AG. Thus, in [18], the molecular weight distribution (MWD) of larch AG samples was determined by the SEC method on an Agilent 1200 chromatograph with a 1260 Infinity refractometric detector (30°C), PL Aquagel-OH 40 300 × 7.5 mm, 0.1 M LiNO3, and 1 mL/min). The column was calibrated using standard samples of dextran (Sigma-Aldrich) with molecular masses of 10600, 20000, 41272, and 70000 Da. As the feedstock, we used AG obtained by the original method [18] from Siberian larch wood (Larix sibirica Ledeb.). The infrared spectra and MWD of arabinogalactan sulfates in the form of sodium and ammonium salts, obtained using various sulfating reagents, were compared. According to the data obtained,

the investigated sulfated derivatives and the initial samples of AG differ noticeably in terms of hydrogen bonds and molar mass distribution. In [23], the synthesis of guar gum sulfates by a complex of sulfur trioxide with 1,4-dioxane was studied. It is shown that the following optimal conditions for sulfation of guar gum with sulfur trioxide-1,4-dioxane complex were established: temperature 60 °C, duration 2.9 h, and volume of chlorosulfonic acid 3.1 ml. The presence of sulfate groups in the structure of guar gum was confirmed by elemental analysis and Fourier transform infrared spectroscopy (FT-IR). Sulfated guar gum has also been characterized by X-ray diffraction analysis, scanning electron microscopy, and gel chromatography. From gel chromatography data, it was shown that during the sulfation of guar gum with a sulfur trioxide complex with 1,4-dioxane, the molecular weight decreases from 600 to 176 kDa.

Sulfated derivatives of the galactomannan family have a variety of biological activities. In [24], sulfated galactomannan was obtained from fenugreek gum in a chlorosulfonic acid/pyridine medium. To obtain derivatives with the highest degree of substitution (DS), the optimal conditions for sulfation were determined in the experiment according to the Box-Behnken scheme. Analysis of the quadratic regression model confirmed that reaction time was the most significant DS exposure parameter. Under the chosen conditions, the maximum value of the degree of sulfation was obtained at 0.490. The results of FT-IR and X-ray photoelectron spectroscopy (XPS) showed the presence of the SO3- group. In 13C NMR spectroscopy, the original C-6 peaks did not completely disappear, and new peaks appeared at δ 63.2 and 64.0, illustrating incomplete substitution, predominantly in the C-6 position. After sulfation, Size exclusion chromatography combined with polygonal laser light scattering (SEC-MALLS) found that the average molecular

weight (Mw) of the sulfated derivatives rapidly decreased. The introduction of negatively charged SO3– groups into the electrostatic interaction and the decrease in MM could have a significant effect on its biological activity [24].

The extraction of carboxymethyl chitosan (CMCHT) from chitosan (Sigma-Aldrich, USA) was carried out as follows. 1.0 g of chitosan was mixed in 25 ml of isopropyl alcohol for 10 minutes at room temperature, and 8 ml of 40% NaOH was added to the suspension. As a result, the suspension was brought to a standstill. After that, another 35 ml of isopropyl alcohol was added to the solution and stirred for 30 minutes at room temperature. After mixing the suspension well, adding 5 g of monochloroacetic acid, the temperature of the solution was raised to 450 °C and stirred for 3 hours. After that, the solution was cooled to room temperature and filtered. After filtration, it was washed with 200 ml of methanol. Then, the sediment was removed from the filter paper and put into a 200 ml beaker, 100 ml of methanol was poured over it, and 10 drops of acetic acid were added. It was covered with foil and stirred at room temperature for 14 hours. Mixing was stopped, and the solution was cooled for 10 minutes. Then the solution was filtered, and the filter was washed with ethyl alcohol 3–4 times. A small sample was taken and dissolved in water to check solubility. The pH value of the dissolved solution was determined to be neutral. The resulting wet precipitate was dried at 500 °C for 12–14 hours and weighed 2.1 grams.

SEC analysis of synthesized CMCHT was carried out in water (Fig. 1a and 2a)
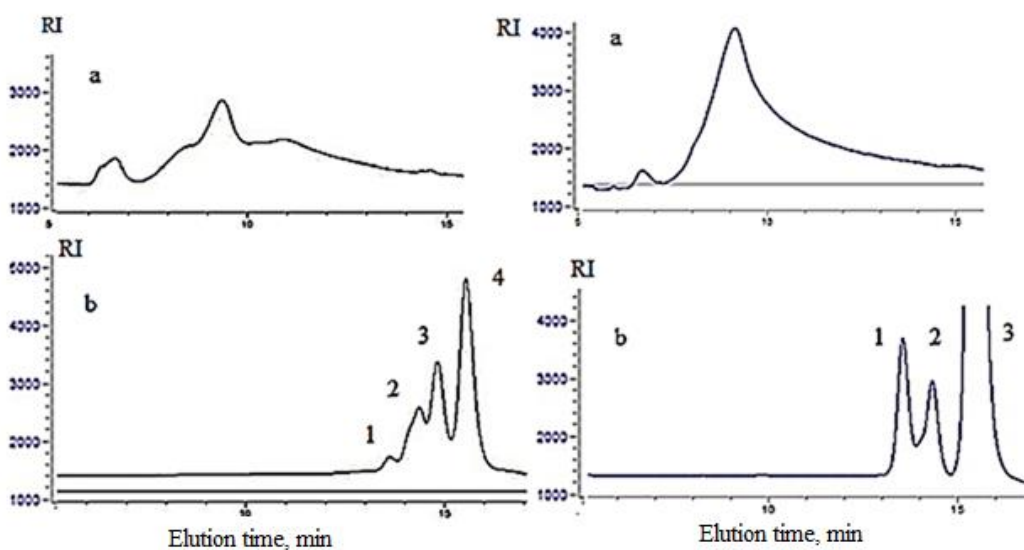
Fig.1 **Fig.2**

Elution chromatograms of carboxymethyl chitosan from Shandong Yinuokang

Pharmaceutical Co., Ltd (China) (Fig.1) and from Black Sea crab (Turkey) (Fig.2). and salt solutions as eluent (Fig.1 b and 2b). Figures 1 and 2, respectively, show the chromatograms of CMCHT obtained from chitosan synthesized by the Chinese Shandong Yinuokang Pharmaceutical Co., Ltd. and CMCHT synthesized by modifying chitin, extracted from the shell of the Black Sea crab (Turkey). The chromatograms presented in Figures 1a and 2a were recorded when water was used as an eluent in SEC, and we can see that the properties of CMCHT molecules describe the polyelectrolyte expansion effect, i.e., the reduction of the

elution time and the multimodal appearance of the elution curves. The reason for this is that, due to the ionization of the carboxyl groups in the CMCHT chain in water, anions move away from each other under the influence of Coulomb forces, that is, macromolecules grow in geometric size. This phenomenon is called the polyelectrolyte expansion effect. Chromatographic peaks with small values occur due to the increase in the size of macromolecules and their early exit from the column before being able to enter the pores on the surface of the sorbent. This anomalous phenomenon was eliminated when a solution of NaNO3 in water with a concentration of 0.1 mol/l was used as an eluent. As a result of the screening (blocking) of anionic groups by Na+ ions in water, the forces of electrostatic interaction decrease, and the polymer chain becomes neutral. In this case, the elution time corresponding to the peaks of the chromatograms increases, and the symmetry of the chromatograms becomes visible. This situation indicates that the molecular sieve separation mechanism of

SEC is activated (Figures 1b and 2b). As can be seen from Figures 1b and 2b, the samples consist of 4 and 3 fractions, respectively. Fractions 1, 2, 3 in Figure 1 b belong to the CMCHT sample, and peak 4 belongs to the solvent. In Fig. 2b, it was found that fractions 1, 2 belong to CMCHT, and peak 3 belongs to the solvent. SEC was used to study the polyelectrolytic nature and determine the average molecular weights of commercial unfractionated heparin "Heparin-Indar" (Ukraine) and low molecular weight heparin Clexane (Sanofi, France). SEC was performed on an Agilent 1260 Infinity high speed liquid chromatograph (USA) with a refractive index detector. The eluent flow rate was 0.8 ml/min. The volume of the injected sample was 25 µl. Figure 3 shows combined gel chromatograms of low molecular weight heparin brand "Clexane"(SANOFI-AVENTIS FRANCE), obtained at different concentrations of the injected sample in water (curves 1.2, 3) and in an aqueous solution of 0.1 M NaNO3 (curve 4).
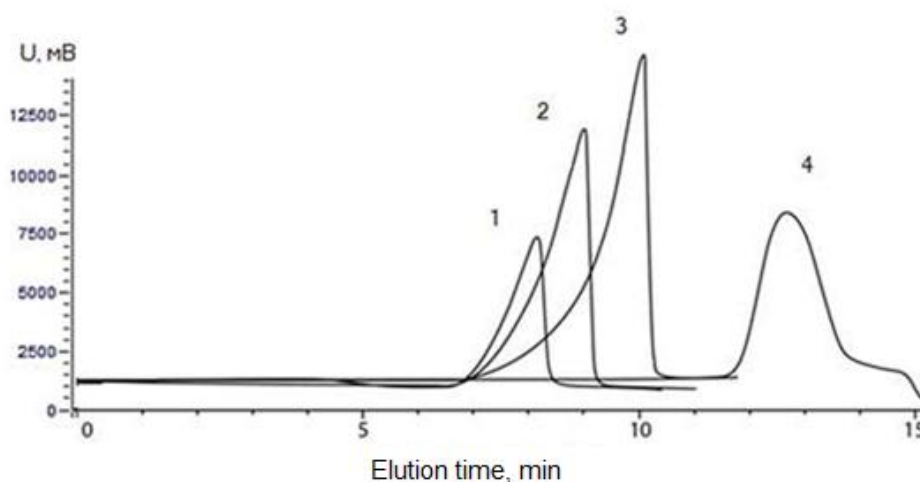
Fig.3. Overlapped chromatograms of heparin "Clexane" in water (1,2,3) and salt solution (0.1M NaNO3) (4). Concentrations at peaks, g/dl: 1 – 0.05; 2 -0,1; 3-0.2

It can be seen from the figure that, without the addition of neutral salt or water, the chromatograms have asymmetric shapes, and the retained volumes (or elution time) decrease with decreasing polymer concentration in the solution, which characterizes the presence of the polyelectrolyte swelling effect in the chromatographic system. With the use of an aqueous solution having the neutral salt

(NaNO$_3$) with a concentration of 0.1 mol/l as an eluent, electrostatic effects were eliminated. It can be seen from Fig.4, where separation of two commercial heparins: Heparin-Indar (Ukraine) and low molar mass heparin "Clexane".
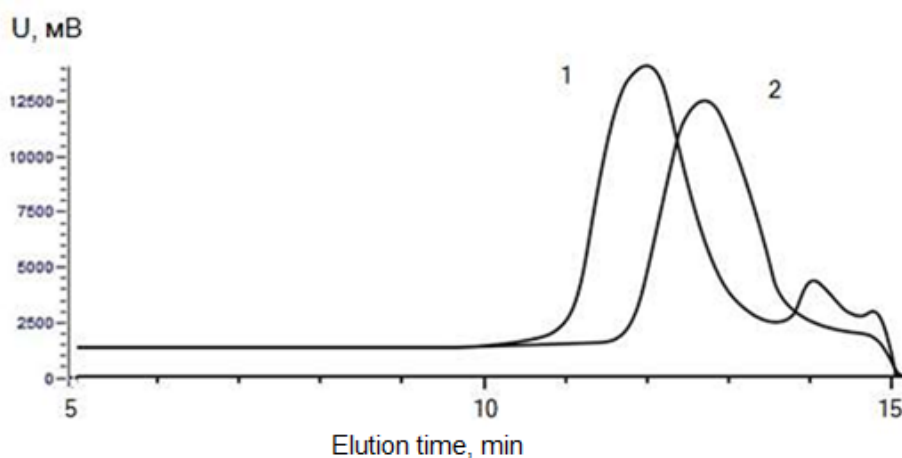
Fig.4. Overlapped chromatograms of Heparin-Indar (M=15 kDa) (1) and low molar mass heparin "Clexane" (M=4.5 kDa) (2)

Note that the suppression of the electrostatic effects of the samples during the SEC process occurs due to the screening of the Coulomb repulsive forces of sulfate groups in the chains of heparin molecules due to the presence of NaNO3 salt in water.

Conclusion. In the SEC of anionic polysaccharides, such as carboxymethyl chitosan and heparin, the separation mechanism in pure water as eluent is distorted by the polyelectrolyte expansion effect. In these cases, elution profiles of chromatograms will have an asymmetric form, and retention times (volumes) will decrease at small concentrations of injected solutes. In eluent containing 0.1 moles/l of NaNO$_3$, electrostatic effects were suppressed.

References

1. Alban S., Schauerte A., Franz G. // Carbohydrate Polym. 2002 V. 47. P. 267–276.

2. Yang L, Zhang L-M. Chemical structural and chain conformational characterization of some bioactive polysaccharides isolated from natural sources. Carbohydr Polym. 2009; 76: 349–61.

3. Dorea CMPG, Alvesa MGCF, Willa LSEP, Costa TG, Sabryb DA, et al. (2012) A sulfated polysaccharide, fucans, isolated from brown algae Sargassum vulgare with anticoagulant, antithrombotic, antioxidant and anti-inflammatory effects. Carbohydrate Polymers 91: 467-475.

4. Goun, E.A. Anti cancer and anti thrombin activity of Russian plants/ E.A. Goun, V.M. Petrichenko, S.U. Solodnikov, T.V. Suhinina // Journal of Ethnopharmacol. - 2002. - Vol. 81. - P. 337-342.

5. Siddhanta, A.K. Sulfated polysaccharides of Codium dwarkense Boergs from the west coast of India: chemical composition and blood anticoagulant activity/ A.K. Siddhanta, M. Shanmugam, K.H. Mody, A.M. Goswami, B.K. Ramavat// International Journal of Biological Macromolecules. -1999. - V. 26, №2. - P. 151-154.

6. Дрозд, Н.Н. Антикоагулянтная активность экстрактов коры кедра, цианинов коры ели, березы и целлюлозы, выделенной из древесины осины, пихты и соломы

пшеницы/ Н.Н. Дрозд, С.А. Кузнецова, Н.Т. Мифтахова, В.А. Макаров, Н.Ю. Васильева// Экспериментальная и клиническая фармакология. - 2010. - Т.73, №6. - С. 5-9.

7. Astrup, T. Polysaccharide Sulfuric Acids as Anticoagulants / Tage Astrup, Ib Galsmar, Mogens Volkert // Acta Physiol. Scand. - 1944. - Vol. 8, № 23. - P. 215-226.

8. Morrow, P. Gastrointestinal nonabsorption of sodium cellulose sulfate labeled with sulfur / Paul E. Morrow, Harold C. Hodge, W. F. Neuman, Elliott A. Maynard, Harvey J. Blanchet, Jr., David W. Fassett, R. E. Birk, Spencer Manrodt // J. Pharmacol. Experiment. Therap. - 1952. - Vol. 105, № 3. - P. 273-281.

9. Розкин, М.Я. Сравнительное исследование антикоагулянтной активности сульфатированных полисахаридов бурых морских водорослей / М.Я. Розкин, М.Н. Левина, В.С. Ефимов, А.И. Усов. // Фармакол. и токсикол.-1988.- № 4.- С. 63-68.

10. Местечкина, Н. М. Антикоагулянтная активность низкомолекулярных сульфатированных производных галактоманнана семян Cyamopsis tetragono-loba / Н.М. Местечкина, В.Д. Щербухин, Г.Е. Банникова, В.П. Варламов// Прикладная биохимия и микробиология. - 2008. - Т.44, №1. - С.111-116.

11. Патент №2532915 РФ. Способ получения сульфатированных производных арабиногалактана, обладающих антикоагулянтной и гиполипидемической активностью/ Я.А. Костыро, В.К. Станкевич, Б.А. Трофимов. - 2013136817/04; Заявлено 06.08.2013; Опубликовано 20.11.2014, Бюл. №2. - С. 4

12. Патент №2319707 (РФ). Способ получения сульфатированных производных арабиногалактана, обладающих антикоагулянтной и гиполипи-димической активностью / Я.А. Костыро, Т.В. Ганенко, С.А. Медведева, Б.Г. Сухов, Б.А. Трофимов / 20.03.2008.

13. Shurygina I.A., Sukhov B.G., Fadeeva T.V., Umanets V.A., Shurygin M.G., Ganenko T.V., Kostyro Y.A., Grigoriev E.G., Trofimov B.A. Bactericidal action of Ag(0)-antithrombotic sulfated arabinogalactan nanocomposite: coevolution of initial nanocomposite and living microbial cell to a novel nonliving nanocomposite // Nanomedicine: Nanotechnology, Biology and Medicine. 2011. Vol. 7. N6. Pp. 827–833. DOI: 10.1016/j.nano.2011.03.003.

14. Костыро Я.А., Ковальская Г.Н. Сульфатированный арабиногалактан – перспективный отечественный аналог сулодексида // Acta Biomedica Scientifica. 2008. Т. 60. №2. С. 117.

15. Дрозд Н.Н., Кузнецова С.А., Лапикова Е.С., Давыдова А.И., Макаров В.А., Кузнецов Б.Н., БутылкинаА.И., Васильева Н.Ю., Скворцова Г.П. Антикоа-гулянтная активность in vitro сульфатированного арабиногалактана и экстракта коры кедра // Экспериментальная и клиническая фармакология. 2008. Т. 71. №4. С. 30–34.

16. С.А. Кузнецова, Н.Ю. Васильева, Н.Н. Дрозд, М.А. Михайленко, Т.П. Шахтшнейдер, Ю.Н. Маляр, Б.Н. Кузнецов, Н.В. Чесноков. Сульфатированные производные арабиногалактана и их антикоагулянтная активность, Химия растительного сырья. 2019. №4. С. 47–56.

17. Казаченко А.В. Синтез и физико-химическое исследование функцио-нальных полимеров на основе сульфатов арабиногалактана и микрокристал-лической целлюлозы. Дисс.канд.хим.наук. Красноярск, 2017, 118 с.

18. С.А. Кузнецова, Н.Ю. Васильева, Н.Н. Дрозд, М.А. Михайленко, Т.П. Шахтшнейдер, Ю.Н. Маляр, Б.Н. Кузнецов, Н.В. Чесноков. Сульфатированные производные арабиногалактана и их антикоагулянтная активность// Химия растительного сырья. 2019. №4. С. 47–56.

19. Y. N Malyar, N. Yu Vasilyeva, A. S Kazachenko, V. S Borovkova, A. M Skrip-nikov, A. V Miroshnikova, D. V Zimonin, V.A Ionin, A. S Kazachenko, N. Issaoui

.Modification of Arabinogalactan Isolated from Larix sibirica Ledeb. into Sulfated Derivatives with the Controlled Molecular Weights // Molecules 2021 Sep 3;26 (17):5364. doi: 10.3390/molecules26175364.

20. A V Levdansky, N Yu Vasilyeva, A A Kondrasenko, V A Levdansky, Yu N Malyar, A S Kazachenko, B N Kuznetsov. Sulfation of arabinogalactan with sulfamic acid under homogeneous conditions in dimethylsulfoxide medium // Wood Sci Technol. 2021;55(6):1725-1744. doi: 10.1007/s00226-021-01341-2. Epub 2021 Oct 20.

21.Aleksandrova, G.P., Sapozhnikov, A.N., Boymirzaev, A.S., Sukhov, B.G., Trofimov, B.A. Nanobiocomposites of Pharmacophoric Iron and Bismuth Oxides with Arabinogalactan Matrix. Russian Journal of General Chemistry, 2020, 90(4), c. 672–679

22. Aleksandrova, G.P., Boymirzaev, A.S., Klimenkov, I.V., Sukhov, B.G., Trofimov, B.A. Modirication of the arabinogalactan matrix in the formation of metal-polymer nanobiocomposities. Nanotechnologies in Russia, 2019, 14(1-2), c. 41–47.

23. A. S. Kazachenko, F. Akman, A. Sagaama, N. Issaoui, Y. N. Malyar, N. Yu. Vasilieva, V. S. Borovkova. Journal of Molecular Modeling (2021) 27: 5, c.1-15

24. Hao Wang, Tiantian Chen, Hui Zhang, Junyu Liang, Weibao Kong, JianYao, Ji Zhang, Junlong Wang. Synthesis and structure characterization of sulfated galactomannan from fenugreek gum. International Journal of Biological Macromolecules. V.125, 2019, P 1184-1191).

MECHANICS AND ENGINEERING

UDC 621.3.082.782

DEPENDENCE OF THE TWO-DIMENSIONAL COMBINED DENSITY OF STATES ON THE ABSORBING PHOTON ENERGY IN GaAs/AlGaAs AT QUANTIZING MAGNETIC FIELD

ERKABOEV ULUGBEK

Professor of Namangan Institute of Engineering and Technology
E-mail: erkaboev1983@gmail.com, phone: (+99893) 0523883

SAYIDOV NOZIMJON

Doctoral student of Namangan Institute of Engineering and Technology
E-mail: sayidovnozimjon@gmail.com, phone: (+99899)8705868

Abstract:

Objective. The influence of the two-dimensional density of states on the oscillations of the transverse electrical conductivity in heterostructures with rectangular quantum wells is studied. A new analytical expression is derived for calculating the temperature dependence of the oscillations of the transverse electrical conductivity and magnetoresistance of a quantum well.

Methods. Oscillations of the electrical conductivity and magnetoresistance of a narrow-window quantum well with a nonparabolic dispersion law are studied. The proposed theory was used to study the results of experiments on a narrow-gap quantum well ($In_xGa_{1-x}Sb$).

Results. A new analytical expression is derived for calculating the temperature dependence of the oscillations of the transverse electrical conductivity and magnetoresistance of a quantum well. A mechanism has been developed for the oscillation of the transverse electrical conductivity and magnetoresistance of a quantum well from the first-order derivative of the magnetic field (differential $\frac{\partial\left(\rho_\perp^{2d}(E,B,T,d)\right)}{\partial B}$) at low temperatures and weak magnetic fields.

Conclusion. Oscillations of the electrical conductivity and magnetoresistance of a narrow-window quantum well with a nonparabolic dispersion law are studied. The proposed theory was used to study the results of experiments on a narrow-gap quantum well ($In_xGa_{1-x}Sb$). The Landau levels of the $In_xGa_{1-x}Sb$ quantum well in weak magnetic fields, which were not observed in the experiment, oscillate. This has been proven through the $\frac{\partial\left(\rho_\perp^{2d}(E,B,T,d)\right)}{\partial B}$ theory of magnetoresistance. The experiment shows that the oscillations of the transverse magnetoresistance of the $In_xGa_{1-x}Sb$ quantum filament, measured at a temperature of 2 K, transform into a continuous energy spectrum due to thermal washing under the influence of the temperature growth dynamics.

Keywords: semiconductor, magneto-optical absorption coefficient; Landau levels; oscillations of the combined density of states; modeling; pressures; temperatures.

Introduction. As is known, the influence of external factors (temperature, magnetic field and pressure) on quantum–dimensional heterostructures leads to a change in the position of the energy levels of charge carriers and, consequently, to a shift of the magneto-optical absorption edge[1-20]. The magneto-optical absorption spectrum of nanoscale semiconductors is determined by the energy distance between different minima of the sparse zone. Hence, the width of the forbidden zone of the quantum well can either decrease or increase due to external influences. Thus, the study of the magneto-optical absorption spectrum near the boundary of its absorption edge provides information about the structure of the energy spectrum of charge carriers near the lower edge of the conduction band and near the upper edge of the valence band of the quantum well, which is essential for determining the magnetic, optical and

electrical properties of nanoscale semiconductors.

The combined densities of quantum well states play an important role in the oscillation of interband magneto-optical absorption. Therefore, in many cases, the matrix element (p_{cv}) changes little within the Brillouin zone.

Consequently, the structure of the spectrum mainly determines the combined density of states in quantum-dimensional heterostructures. In works [1-3], a method was developed for calculating the oscillation of the combined density of states in a quantizing magnetic field with a non-quadratic law of dispersion under the influence of temperature and hydrostatic pressure. This method is used in the study of magnetic absorption in narrow-band semiconductors with a nonparabolic dispersion law. A fan diagram of the magnetic absorption spectrum in narrow-band semiconductors is constructed. However, these papers do not consider the temperature dependence of the two-dimensional combined density of states in the allowed zone of a quantum well with a parabolic law of dispersion. That is, the resulting method is applicable only for bulk semiconductor materials.

In addition, in works [4,5], the spectrum of InGaN/AlGaN/GaN heterostructures with quantum wells is emitted by an LED and analyzed on the basis of a two-dimensional combined density of states model. The considered model of approximation of the luminescence spectra of LEDs in these works was developed for complex heterostructures with multiple quantum wells. In work [6], a random walk in a two-dimensional space consisting of an energy parameter of the order and an energy correlation function was performed, and a two-dimensional combined density of quantum well states was obtained. The order parameter, susceptibility and correlation function are calculated from the two-dimensional combined density of quantum well states. Numerical calculations of the author show that for the purposes of determining the two–dimensional combined density of states in continuous models, the Wang–Landau transition matrix method can be considered as an alternative to the pure Wang-Landau method. In work [7], an exact mathematical expression is proposed that directly combines the density functions of the states of the resolved zone of a quantum well to create a two-dimensional combined density of states for direct transitions. Using both expressions, the absorption coefficient of the quantum well and the superlattice was calculated, which led to a positive coincidence with the experimental data. In the above literature, the temperature dependence of the oscillation of the two-dimensional combined density of quantum well states in a quantizing magnetic field is not discussed. Also, the work determines the oscillations of the combined density of quantum well states at constant temperatures in the absence of a magnetic field.

Methods. The purpose of this work is to determine the effect of a strong magnetic field on the combined density of states in heterostructures with quantum wells.

In the absence of a magnetic field, the dependence of the density of the energy states of the conduction band and the valence band in the quantum well on the energy spectrum of charge carriers are step functions (Fig.1a) [21]:

$$g_c(E) = \frac{m_n^e}{\hbar^2 \pi} \sum_n \theta(E - E_n)$$

$$g_v(E) = \frac{m_n^h}{\hbar^2 \pi} \sum_m \theta(E - E_m)$$

(1)

Here, m_n^e and m_n^h are the effective masses of electrons and holes in the dimensional quantization subband in a quantum well numbered n and m. θ(E) - Heaviside step function.

For direct interband transitions, the combined densities of states are a convolution in energy, which also has a step function in energy [21]:

$$N_{jds}^{2d}(E) = \frac{m_{mn}^{*}}{\hbar^{2}\pi}\sum_{m,n}\theta(E - E_{mn}) \tag{2}$$

Here, m_{mn}^{*} is the reduced effective mass of charge carriers for the subzones of dimensional quantization n and m, which is calculated by the ratio: $(m_{mn}^{*})^{-1} = (m_{n}^{e})^{-1} + (m_{m}^{h})^{-1}$.
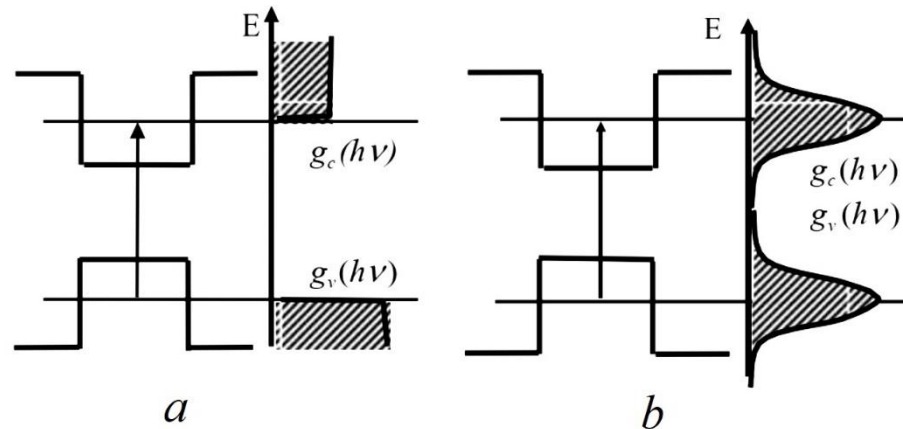

Fig.1. The energy distribution of the density of electronic states in quantum-dimensional GeSi/Si structures [21]: *a* - quantum well, *b* - quantum dot

If the electronic and hole states in *GeSi* structures turn out to be size-quantized in all three quasi-momentum components, that is, they represent a quantum dot for charge carriers, then in this case the combined density of states in the allowed band of such a structure is a Gaussian function (Fig. 1b). Then, in the allowed zone there is a zero-dimensional combined density of states, which is a discrete non-decreasing function. In this case, the combined density of states is described using the so–called Dirac delta function $\delta(E)$:

$$N_{jds}^{0d}(E) = \sum_{l,m,n} \delta(E - E_{lmn}) \tag{3}$$

The combined density of states is a collection of infinitely narrow and high peaks (Fig.1b). All the results obtained above are valid for cases without the influence of quantization of the magnetic field, temperature and pressure. Specific questions arise: how to determine the combined density of states in quantum-dimensional direct transitions of heterostructures in the presence of a strong magnetic field? How does the dynamics of temperature rise affect this process?

Let's calculate the dependence of the combined density of states on the quantizing magnetic field in two-dimensional semiconductor materials with direct allowed transitions. In a quantizing magnetic field, the combined density of states is defined as an integral over all states in the conduction band with energies E_C and in the valence band with energies E_V of the quantum well, which satisfy the law of conservation of energy during the magneto-optical transition. Let us analyze the simplest model of a band structure near the edge of the band gap of a straight-band heterostructure with a quantum well under the influence of a strong magnetic field. That is, the valence band of the quantum well is completely filled with charge carriers, and the conduction band is empty. Here, the filling functions of the corresponding states are equal to $f_V=1$, $f_C=0$. In addition, in this model, the

dependence of impurity levels on the combined density of quantum well states with the parabolic law of dispersion can be neglected. The magnetic field inductions are directed across (along the Z axis) and will be perpendicular to the XY plane. This is called a transverse quantum magnetic field.

Hence, in the presence of a strong magnetic field, the laws of dispersion energy are used to calculate the combined density of quantum well states, which can be written as follows:

$$E_c^{2d}(B,d,n_{cZ}) = \left(N_L^c + \frac{1}{2}\right)\hbar\omega_c^c + \frac{\hbar^2\pi^2}{2m_c d^2}n_{eZ}^2 + m_s^c g_c \mu_B H$$

$$E_v^{2d}(B,d,n_{vZ}) = -\left(N_L^v + \frac{1}{2}\right)\hbar\omega_c^v - \frac{\hbar^2\pi^2}{2m_v d^2}n_{vZ}^2 - m_s^v g_v \mu_B H - E_g^{2d}(0)$$

(4)

Here, N_L^c, N_L^v is the number of Landau levels of charge carriers in the allowed zone of the quantum well; ω_c^c, ω_c^v is the cyclotron frequency of the magnetic field in the conduction band and valence band of the quantum well; d is the thickness of the quantum well; n_{eZ}^2, n_{vZ}^2 is the number of the dimensional quantization subzone in the conduction band and in the valence band of the quantum well; n_{eZ}, n_{vZ} is the ordinal number of the quantization levels of electrons and holes along the Z axis, respectively.

Imagine that the electron and valence bands are symmetric, then the condition $n_{eZ} = n_{vZ} = n_Z$ is fulfilled. $m_s^c g_c \mu_B H, m_s^v g_v \mu_B H$ is the spin energy in the allowed zone; $E_g^{2d}(0)$ is the width of the forbidden zone of the quantum well at absolute zero temperature; B is the induction of the magnetic field.

For $E_c^{2d}(B,d,n_Z)$ and $E_v^{2d}(B,d,n_Z)$, without taking into account spin, magneto-optical transitions will correspond to the law of conservation of energy

$$E_{cv}^{2d}(B,d,n_Z) = E_c^{2d}(B,d,n_Z) - E_v^{2d}(B,d,n_Z)$$

$$E_{cv}^{2d}(B,d,n_Z) = E_g^{2d}(0) + \left(N_L^c + \frac{1}{2}\right)\hbar\omega_c^c + \left(N_L^v + \frac{1}{2}\right)\hbar\omega_c^v + \frac{\hbar^2\pi^2}{2m_{cv}^* d^2}n_Z^2$$

$$h\nu \geq E_{cv}^{2d}(B,d,n_Z)$$

(5)

Where, $h\nu$ is the absorbed photon energy, ν is the frequency of light, $\frac{1}{m_{cv}^*} = \frac{1}{m_c^*} + \frac{1}{m_v^*}$ is the combined (reduced) effective mass.

In the Z direction, a strong magnetic field does not change the relationship between the energy and the wave vector for the movement of charge carriers. However, for the movement of charge carriers in the direction of perpendicular magnetic induction (in the XY plane), the former quasi-continuous series of energy levels is replaced by a system of discrete Landau levels. Since the effective mass of electrons and holes is assumed to be constant, the distance between the Landau levels does not depend on the quantum number, which is $\hbar\omega_c$. Hence, in the conduction band and the valence band of the quantum well, the movement of free electrons and holes in all three directions is limited. When exposed to a quantizing magnetic field, a quantum well becomes an analogue of a quantum dot. And also, the energy spectrum of charge carriers will be entirely discrete. According to equation (3), when replacing E with $\hbar\nu$ and E_{lmn} with $E_{cv}^{2d}(B,d,n_Z)$ in the argument $\delta(E - E_{lmn})$, we have:

$$N_{jds}^{2d}\left(h\nu, E_{cv}^{2d}\left(B, d, N_L^{cv}, n_Z\right)\right) = \frac{eB}{\pi\hbar} \sum_{N_L^c, N_L^v, n_Z} \delta\left(h\nu - E_{cv}^{2d}\left(B, d, N_L^{cv}, n_Z\right)\right) \tag{6}$$

Thus, under the influence of a quantizing magnetic field, the equation (6) can be used to determine the combined density of quantum well states. However, such equations do not take into account the influence of temperature and pressure on the discrete Landau levels of electrons and holes for straight-band quantum wells.

The magneto-optical assimilation range could be a key prerequisite for many volumetric and low-dimensional optoelectronic devices. The method of magneto-optical retention in straight-band heterostructures with quantum wells and $\alpha_B^{2d}(\hbar\nu, B, d)$ can be communicated as a function of the combined thickness of states. When uncovered to a quantizing attractive field, the combined thickness of states gives a degree of the number of permitted magneto-optical moves between the electronic states of the filled valence band and the vacant electronic states of the conduction band isolated by the photon vitality $\hbar\nu$. In well-known logical writing, a few endeavors have been detailed to relate the densities of the vitality states of the allowed zone with the combined thickness of states within the nonattendance and nearness of a attractive field. [4-7]. Be that as it may, all the experimental and rearranged expressions of the combined thickness of states gotten were restricted by the nonappearance of weight and at moo temperatures.

From equation (6) it is clear that for $h\nu > E_{cv}^{2d}(B, d, N_L^{cv}, n_Z)$, the form of the combined density of states as a function of energies reflects the nature of deltoidness. When exposed to a quantizing magnetic field, the two-dimensional combined density of states $N_{jds}^{2d}\left(h\nu, E_{cv}^{2d}(B, d, N_L^{cv}, n_Z)\right)$ it is determined by the energy spectrum of charge carriers in the allowed zone of the quantum well. Experiments show that the density of states of electrons and holes depends on temperature. The temperature dependence of the density of states of electrons and holes in a quantum well is explained by the thermal blurring of discrete Landau levels [22-25]. As shown in works [23,24], the density of electron states in the conduction band of a quantum well at sufficiently high temperatures transforms from discrete Landau levels into a continuous energy spectrum. And at low temperatures, the quantizing magnetic field strongly affects the densities of states in the resolved zone of the quantum well, whereas the continuous energy spectrum decomposes into discrete Landau levels. In this case, as the temperature increases, collisions of charge carriers and thermal motions lubricate the discrete Landau levels, turning it into a continuous spectrum of the density of quantum well states. Hence, the temperature dependence of discrete Landau levels of charge carriers can be described by decomposing the combined density of quantum well states into a series of delta-shaped functions. The temperature dependence of the oscillation of the interband magneto-optical absorption in heterostructures with quantum wells was explained by a study using the delta-shaped functions of two-dimensional combined densities of states. The temperature dependence of the two-dimensional combined density of states is determined by thermal broadening of discrete Landau levels of charge carriers in the allowed zone of the quantum well.

At T=0, the Gaussian distribution function is delta-shaped and is defined by the following expression [26]:

$$Gauss(E, T) = \frac{1}{kT} \cdot \exp\left(-\frac{(E - E_i)^2}{(kT)^2}\right) \tag{7}$$

In addition, to describe the interband magneto-optical absorption, it is usually assumed that each energy spectrum of a quantum well is blurred according to the Gaussian law with a blurring parameter. This approach can be described by the temperature dependence of the two-dimensional combined density of states in a quantum well. Hence, the deep filled discrete Landau levels of charge carriers in a quantum well depend exponentially on the two-dimensional combined density of states. To calculate the temperature dependence of the two-dimensional combined density of states $N_{jds}^{2d}(h\nu, E_{cv}^{2d}(B,d,n_Z))$ we assume that $N_{jds}^{2d}(\hbar\nu, E_{cv}^{2d}(B,d,N_L^{cv},n_Z))$ for T=0 equal to the known energy functions $E_{cv}^{2d}(B,d,N_L^{cv},n_Z)$. For a heterostructure with quantum wells, in a strong magnetic field, the two-dimensional combined density of states is calculated by the equation (6). With increasing temperature, each combined density of states in the allowed zone of the quantum well with the energy of the conduction band and the valence band $E_{cv}^{2d}(B,d,N_L^{cv},n_Z)$ is eroded. Thermal blur $N_{jds}^{2d}(h\nu, E_{cv}^{2d}(B,d,N_L^{cv},n_Z))$ with energy $E_{cv}^{2d}(B,d,N_L^{cv},n_Z)$ is calculated by the Shockley-Reed-Hall statistics [27]. Thus, under the influence of a quantizing magnetic field, in the permitted zone of the quantum well, the resulting two-dimensional combined density of states, taking into account the contribution of thermal blurring of all states, will be determined by the sum of all blurring. Hence, at a finite temperature T, this reduces to the decomposition into a series $N_{jds}^{2d}(h\nu, E_{cv}^{2d}(B,d,N_L^{cv},n_Z))$ by Gaussian functions, for nanoscale semiconductor structures.

The equation (6) does not take into account thermal blurring of the two-dimensional combined density of states. If we decompose $N_{jds}^{2d}(h\nu, E_{cv}^{2d}(B,d,N_L^{cv},n_Z))$ in a row according to equations (7), then it is possible to take into account the temperature dependence of the two-dimensional combined density of states in the allowed zone of the quantum well. In a strong magnetic field, temperature blurring of the combined density of quantum well states leads to smoothing of discrete Landau levels of charge carriers, and thermal blurring is calculated using the equation (7). At T=0, the equation (7) turns into a delta-like function of the form:

$$\underset{T\to 0}{Gauss}\left(E, E_i, T\right) \to \delta\left(E - E_i\right) \tag{8}$$

Thus, it follows from equations (5), (6) and (7) that under the influence of a quantizing magnetic field, the temperature dependence of the combined density of quantum well states is reduced to the following analytical expression:

$$N_{jds}^{2d}\left(h\nu, E_{cv}^{2d}\left(B,T,d,N_L^{cv},n_Z\right)\right) = \frac{eB}{\pi\hbar} \bullet \frac{1}{kT} \bullet$$

$$\bullet \sum_{N_L^c, N_L^v, n_Z} exp\left[-\frac{\left(h\nu - \left(E_g^{2d}(0) + \left(N_L^c + \frac{1}{2}\right)\hbar\omega_c^c + \left(N_L^v + \frac{1}{2}\right)\hbar\omega_c^v + \frac{\hbar^2\pi^2}{2m_{cv}^*d^2}n_Z^2\right)\right)^2}{(kT)^2}\right] \tag{9}$$

Where, $N_{jds}^{2d}\left(\hbar\nu, E_{cv}^{2d}\left(B,T,d,N_L^{cv},n_Z\right)\right)$ - temperature dependence of the oscillation of the combined density of states in the allowed zone of the quantum well in the presence of a strong magnetic field. B is the induction of a transverse quantizing magnetic field.

This new analytical equation expresses the effect of the quantizing magnetic field on the temperature dependence of the two-dimensional combined density of states in

heterostructures with quantum wells. The obtained expression is convenient for processing experimental data on the oscillation of interband magneto-optical absorption in quantum wells at various magnetic fields and temperatures. Thus, a mathematical model describing the effects of external factors (temperature and magnetic field) on the two-dimensional combined density of states in nanoscale semiconductor structures has been obtained.

Results. Now, for specific straight-band heterostructures based on quantum wells, we consider the temperature dependence of the two-dimensional combined density of states in a quantizing magnetic field. In work [28], a high-quality heterostructure with a GaAs/AlGaAs quantum well with a width of 14 nm with a small concentration of aluminum (3%) in the barrier layers was investigated. Heterostructures with a GaAs/AlGaAs quantum well were studied at a temperature of 4 K. In the absence of a magnetic field, the band gap of the GaAs quantum well is equal to 1.464 eV (Fig.2). Fig.2 shows the dependence of the two-dimensional combined density of states on the absorbing photon energy for a GaAs quantum well d=14 nm (n_z=1) at a temperature T=4 K and a quantizing magnetic field B=9 T. This graph was created by numerical calculation based on equation (9). In Fig.2, the number of discrete Landau levels of charge carriers is fourteen. These peaks (discrete Landau levels of charge carriers (N_L^{cv}=14)) are observed in the allowed band of the GaAs quantum well. It shows the two-dimensional combined density of states in a quantizing magnetic field $\hbar\omega_c = 0,02\ eV$ at T=4K, kT=4·10⁻⁴, $\frac{\hbar\omega_c}{kT}=50,\ kT << \hbar\omega_c.$ In this case, the thermal smearing of the Landau levels of charge carriers is very weak and the two-dimensional combined density of states does not feel any deviation from the ideal shape. In this plot, the valence band and conduction band are chosen as symmetrical energy spectra. Then, from the first discrete Landau level of holes ($N_{L(V)}$=0) to $N_{L(V)}$=6, they are located higher from the beginning of the ceiling of the valence band of the quantum well. As well as other discrete Landau levels of electrons are located above the bottom of the conduction band of the quantum well.

Fig.3 appears the impact of temperature on the reliance of the two-dimensional combined thickness of states on the retaining photon vitality in direct-gap heterostructures with GaAs/AlGaAs quantum wells (d=14 nm) beneath the activity of a quantizing attractive field. Here, the sum of acceptance of the quantizing attractive field is 9 T and plots of $N_{jds}^{2d}(\hbar v,\ E_{cv}^{2d}(B,T,d,N_L^{cv},n_z))$ are made for temperatures of 4 K, 20 K, 40 K, 60K, 77 K. It can be seen from Fig.3 that with expanding temperature, the sharp crests of the Landau levels start to smooth out, and at adequately tall temperatures the discrete vitality densities of states turn into nonstop vitality spectra. These comes about were gotten for a steady quantum well thickness and attractive field.
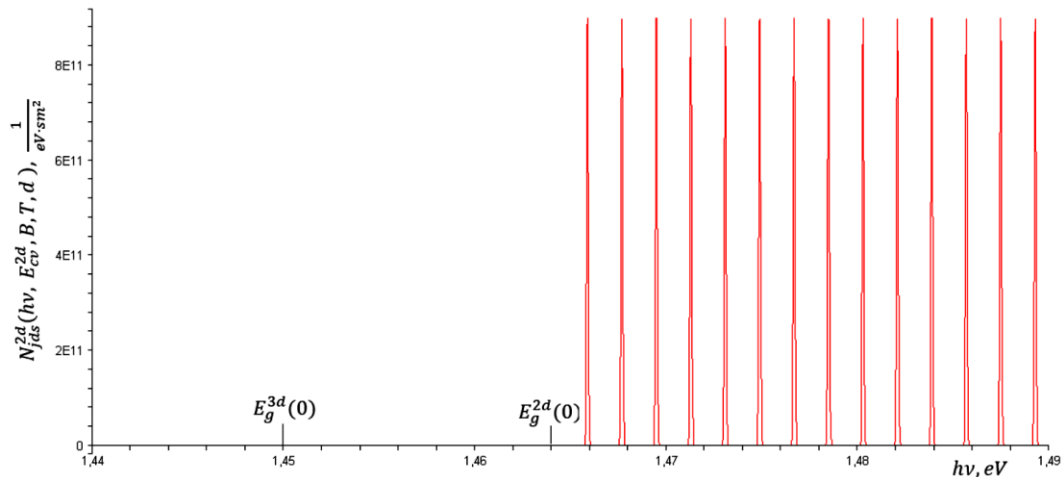
Fig.2. Dependence of the two-dimensional combined density of states on the absorbing photon energy in direct-gap heterostructures with GaAs/AlGaAs quantum wells (d=14 nm) at a temperature T=4 K and a quantizing magnetic field B=9 T

With expanding temperature, the sharp crests of the Landau levels of charge carriers start to smooth out (Fig.3) and at $kT \approx \hbar\omega_c^{cv}$ steadily vanish. Additionally, at adequately tall temperatures $kT > \hbar\omega_c^{cv}$ $N_{jds}^{2d}(\hbar v, E_{cv}^{2d}(B,T,d,N_L^{cv},n_Z))$ they turn into a persistent combined thickness of states of the quantum well and there will be no feel the impact of a quantizing attractive field. In expansion, as the temperature increments, the sharp crests within the Landau levels of charge carriers, due to the quantization of the energy levels of electrons and gaps within the permitted quantum well, steadily smooth out. This leads to the reality that at the temperature T=40 K, kT=3,5·10⁻³, $kT \approx \hbar\omega_c^{cv}$ discrete Landau levels of quantum well charge carriers gotten to be invisible. At a temperature of 77 K, the discrete Landau levels within the permitted band of the GaAs/AlGaAs quantum well are nearly imperceptible and coincide with the two-dimensional combined thickness of states within the nonappearance of a magnetic field. Consequently, the two-dimensional

combined thickness of states within the conduction band and within the valence band of the quantum well are watched at temperatures $kT < \hbar\omega_c^{cv}$. Beginning from temperatures of the arrange of $0.5kT \sim \hbar\omega_c^{cv}$, the two-dimensional combined densities of states due to Landau quantization within the permitted band of the quantum well are not watched.

In this case, the measurements give a continuous spectrum of the two-dimensional combined density of states. Changing the cyclotron frequency of the magnetic field ω_c^{cv} changes the energy distance between discrete Landau levels of charge carriers in the quantum well (Fig.4). On Fig.4 shows graphs of the two-dimensional combined density of states in direct-gap heterostructures with GaAs/AlGaAs quantum wells (d=14 nm) at various magnetic fields B=9 T and 12 T. As can be seen from these figures, with an increase in the induction of the quantizing magnetic field, we obtain a change in the discrete peaks of the Landau levels of charge carriers.
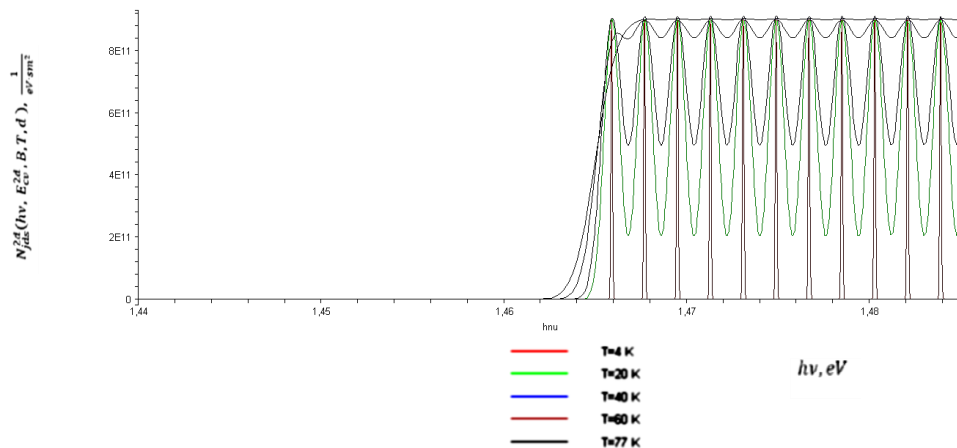
Fig.3. Effects of temperature on the dependence of the two-dimensional combined density of states on the absorbing photon energy in direct-gap heterostructures with GaAs/AlGaAs quantum wells (d=14 nm) under the influence of a quantizing magnetic field B=9 T

Fig.4. Influence of a quantizing magnetic field on the dependence of the two-dimensional combined density of states upon absorption of photon energy in direct-gap heterostructures with GaAs/AlGaAs (d=14 nm) quantum wells at a temperature of T=4K

As is shown from work [29], the impact of a quantizing magnetic field on two-dimensional electron systems will illustrate exceptionally curiously physical properties emerging from the quantum imprisonment of charge carriers in a quantum well. Since of this quantum imperative, the 2D combined thickness of states of charge carriers in a quantum well shows Van Hove singularities, where within the case of an perfect unbounded zero-dimensional cross section (quantum dab), the combined thickness of states tends to boundlessness for well-defined vitality values. Restricting a expansive number of 2D combined densities of states to a single vitality esteem leads to striking physical properties such as greatly tall magneto-optical assimilation, expanded thermoelectric control, quantized electronic conductivity, etc. Applications based on these properties seem lead to imperative unused nanotechnological gadgets and optoelectronic devices.

In particular, in work [30], two-dimensional combined densities of states of heterostructures based on an InGaN/GaN quantum well with different

radiation wavelengths (violet, blue, and green) operating at different currents were studied. The results show that the blue shift of the emission with increasing current is associated with a change in the two-dimensional combined density of states. In this work, the dependence of the two-dimensional combined density of states of the InGaN/GaN quantum well on the absorbing photon energy in the absence of a magnetic field (B=0) and at temperatures T=300 K (Fig.5) was obtained. Here, the band gap of the InGaN/GaN quantum well is Eg(0)=3.2 eV, and the thickness of the quantum well is d=10 nm.

Now, let's apply the proposed model to the InGaN/GaN material. Fig.6 shows the influence of the quantizing magnetic field on the dependence of the two-dimensional combined density of states of the InGaN/GaN quantum well on the energy-absorbing photon at different temperatures. Here, B=10 T, T=300 K, 77 K and 5 K. Figures 5 and 6 show similar results with and without a magnetic field at room temperature. At room temperature, the influence of the magnetic field is not felt when the photon energy of the two-dimensional combined density of states is absorbed, since $kT \gg \hbar\omega_c$. The combined density of states behaves as if there is no magnetic field.

Discussion. It follows from this that the proposed model obeys certain laws, and this indicates the correctness of the model.

Using equation (9), one can observe oscillations of the two-dimensional combined density of states (6) at different low temperatures. Also, a new analytical expression (the proposed new model) allows one to obtain the results of changes in the thickness of the quantum well associated with the combined density of states. This leads to a theoretical analysis of a number of experimental data.

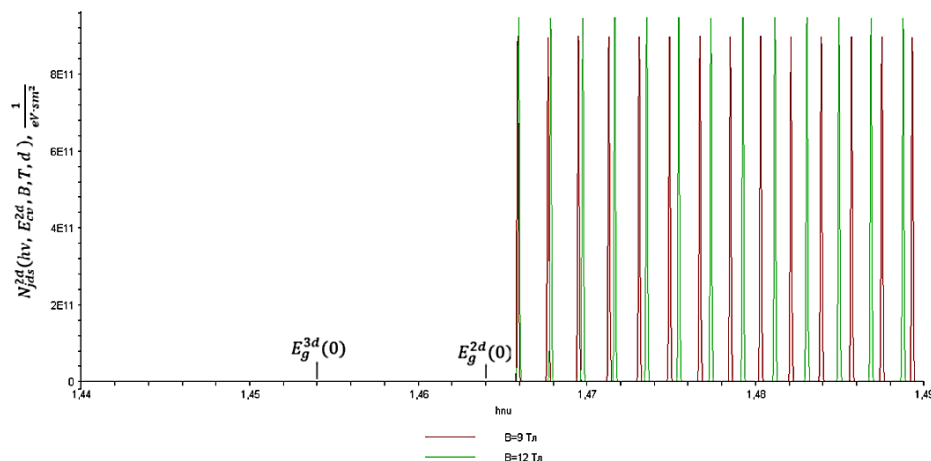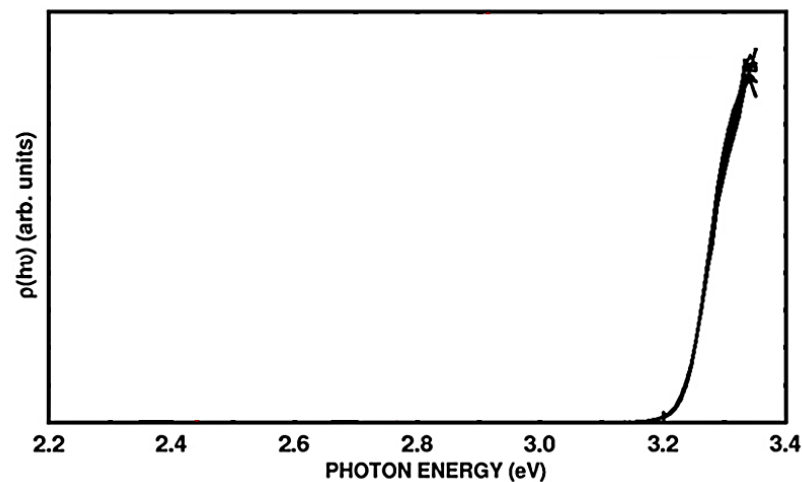**Fig.5. Dependence of the two-dimensional combined density of states on the energy-absorbing photon in direct-gap heterostructures based on an InGaN/GaN quantum well in the presence of a magnetic field and at room temperature [30]**
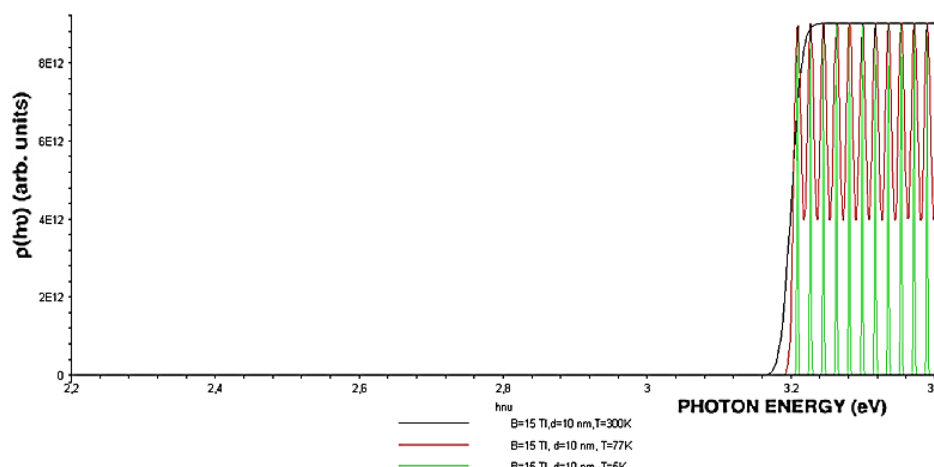
Fig.6. Influence of temperature and quantizing magnetic field on the two-dimensional combined density of states in direct-gap heterostructures based on the InGaN/GaN quantum well. Calculated using the model

Conclusion. Based on the work carried out, the following conclusions can be drawn: An analytical expression is obtained for the oscillations of the two-dimensional combined density of states in the allowed band of a quantum well under the action of a quantizing magnetic field. A new model has been developed for calculating the effect of a quantizing magnetic field on the temperature dependence of the two-dimensional combined density of states in direct-gap heterostructures with quantum wells. The temperature dependence of the oscillations of the two-dimensional combined density of states of the quantum well is explained by the thermal smearing of the Gaussian distribution function in a strong magnetic field. Based on the proposed new models, the Landau levels of charge carriers in a direct-gap quantum well are determined in a wide temperature range. The experimental results were interpreted using the oscillations of the combined density of states of the quantum well in a quantizing magnetic field. The calculation results were compared with experimental results obtained for heterostructures based on an InGaN/GaN quantum well in a quantizing magnetic field at various temperatures.

References

1. G.Gulyamov, U.I.Erkaboev, P.J.Baymatov and A.G.Gulyamov. *International scientific journal for alternative energy and ecology*. № 07-09(2017) 112-120.

2. G.Gulyamov, U.I.Erkaboev and P.J.Baymatov, *International scientific journal for alternative energy and ecology* № 19-20 (2016) 130-138

3. L.R.Ram Mohan, Peter A.Wolff, *Physical Review B.* 26, 12 (1982) 6711-6718.

4. M.L.Badgutdinov, A.É.Yunovich, *Semiconductors,* 42, 4 (2008) 429–438.

5. V.E.Kudryashov, A.N.Turkin, A.E.Yunovich, A.N.Kovalev, F.I.Manyakhin. *Semiconductors*, 33, 4 (1999) 429–434.

6. Shyamal Bhar, Soumen Kumar Roy. *Computer Physics Communications,* 184 (2013) 1387–1394.

7. C.I.Cabrera, D.A.Contreras-Solorio, L.Hernández. *Physica E.* 76 (2016) 103–108.

8. J.Hwang, J.D.Phillips. *Physical review B,* 83(2011) 195327-1-195327-7.

9. Johnson Lee, Harold N. Spector, Wu Ching Chou, Ying Sheng Huang. *Physical review B,* 72 (2005) 125329-1-125329-11.

10.   Dawei Shen, Jinkui Dong, Jialin Shen, Yan Zhang, Binping Xie, Gang Wu, Xianhui Chen, Lei Fang, Haihu Wen, Donglai Feng. *Journal of Physics and Chemistry of Solids*, 69 (2008) 2975– 2977.

11. T.S.Moss, G.J.Burrel, B.Ellis. *Semiconductor opto-electronics*. (Butterworth & Co.Ltd. 1973) 102-130.

12. N.F.Mott, E.A.Davis. *Electronic processes in non-crystalline materials*. (Clarendon press. Oxford. 1971) 250-282.

13. A.Kulkarni, D.Guney, A.Vora. *Nanomaterials*, 2013(2013), 504341

14. U.I.Erkaboev, G.Gulyamov, R.G. Rakhimov, *Indian Journal of Physics*, 96, 8 (2022) 2359–2368.

15. U.I.Erkaboev, U.M.Negmatov, R.G.Rakhimov, J.I.Mirzaev, N.A.Sayidov. *International Journal of Applied Science and Engineering*, 19, 2 (2022) 2021123.

16. U.I.Erkaboev, G.Gulyamov, J.I.Mirzaev, R.G.Rakhimov, N.A.Sayidov. *Nano*, 16, 9 (2021) 2150102.

17. U.I.Erkaboev, R.G.Rakhimov, N.A.Sayidov. *Modern Physics Letters B*, 35, 17 (2021) 2150293.

18. G.Gulyamov, U.I.Erkaboev, N.A.Sayidov, R.G.Rakhimov. *Journal of Applied Science and Engineering*, 23, 3 (2020) 453–460.

19. U.I.Erkaboev, G.Gulyamov, J.I.Mirzaev, R.G.Rakhimov. *International Journal of Modern Physics B*, 34, 7 (2020) 2050052.

20. G.Gulyamov, U.I.Erkaboev, R.G.Rakhimov, J.I.Mirzaev. *Journal of Nano- and Electronic Physics*, 12, 3(2020) 03012.

21. L.V.Grigoriev. Silicon photonics. Course of lectures (part 1).(St. Petersburg: ITMO University, 2016)

22. G.Gulyamov, U.I.Erkaboev, N.Yu.Sharibaev, *Semiconductors,* 48, 10 (2014) 1323-1328.

23. G.Gulyamov, U.I.Erkaboev, N.Yu.Sharibaev, *Modern physics letters B*, 30, 7 (2016) 1650077.

24. G.Gulyamov, U.I.Erkaboev, P.J.Baymatov, *Advances in condensed matter physics,* 2016 (2016) 5434717.

25. G.Gulyamov, U.I.Erkaboev, A.G.Gulyamov, *Advances in condensed matter physics*, 2017 (2017) 6747853.

26. D.Schoenberg, Magnetic oscillations in metals.(New York, Wiley. 1986) pp.350-400.

27. L.S. Stilbans. Physics of semiconductors. ("Soviet Radio", Moscow. 1967) pp. 416-421.

28. A.V.Mikhailov, A.V.Trifonov, O.S.Sultanov, I.Yu.Yugova, I.V.Ignatiev. *Semiconductors*, 56, 7 (2022) 672-676.

29. U.I.Erkaboev, R.G.Rakhimov, N.A.Sayidov, J.I.Mirzaev. *Indian Journal of Physics,* (2022)

30. Yu-Shou Wang, Nai-Chuan Chen, Chun-Yi Lu, Jenn-Fang Chen. *Physica B,* 406 (2011) 4300–4303.

UDC 621. 398

INVESTIGATION OF ELECTROMAGNETIC CURRENT TRANSFORMER PERFORMANCE CHARACTERISTICS FOR MEASURING AND CONTROLLING THE REACTIVE POWER DISSIPATION OF A SHORT-CIRCUITED ROTOR SYNCHRONOUS MOTOR

SIDDIKOV ILHOM

Tashkent University of Information Technologies named after Muhammad al-Khorazmi
E-mail: ikhsiddikov@mail.ru, phone: (+99894) 600-98-77

DENMUXAMMADIYEV AKTAM

Tashkent Institute of Irrigation and Agricultural Mechanization Engineers
E-mail: aktam@gmail.com, phone: (+99891) 456-22-55

A'ZAMOV SAIDIKROM

Doctoral student of Andijan machine building institute
E-mail: azamovsaidikrom1992@gmail.com, phone: (+99891) 940-31-33

Abstract:

Objective. We know that we have been using asynchronous motors, which are widely used in the industry and production of the world and in our country, and despite a number of advantages of this type of motor, there are also enough disadvantages. In order to eliminate these shortcomings, the aim of the article is to reduce the rapid burning of the asynchronous motor by adding an additional sensitive element to the stator slot of the asynchronous motor. and in order to prevent premature failure, the recommended method is effective enough to increase energy consumption and service life. It is known that the main reasons for the failure of the motor are the asymmetry of the electrical parameters in the motor, the increase in temperature and the reduction of energy consumption. In order to prevent the negative consequences of the motor, current transformers serve to further increase the efficiency of the device and to detect and protect the motor's bad condition in advance.

Results. The values based on the results obtained by the voltage signal from the stator of the asynchronous motor were calculated, and the results were compared with the previous scientific works of our Republic and international scientists, studied by the authors and presented in the review of the literature.

Conclusion. Today, there are various methods of controlling and controlling electric motors. The method we recommended and tested in practice is the most modern, high-precision, fast and compact, and gives positive results in controlling and controlling motors used in the industrial production and national economy of our country.

Keywords: Magnetic driving force, voltage, current, output voltage, contact, circuit, converter, asymmetry

Introduction. Today, the demand for electricity is day-to-day energy production, which means the production of renewable energy sources, construction modernization and the provision of quality and uninterrupted electricity generation. is required. part is one of the most issues.

It is seen that the power of our republic in this country, which has industrial production and production capacity, is produced by renewable energy sources. We know that power transformers and induction motors consume electricity. Based on induction motors, it is important to control the main power consumption. To do this, the reactive power of the aschron motor is controlled, the reactive energy path, safety and control, the production and control of various current converters, a series of devices and production of re-power and counting signals, such as current transformers, magnetic - galvanic converters, thermocouples, pyrometers, hall sensors, analyzers, contact and non-contact current converters, etc.

Analyzes of current constructors and sensors were performed and results were obtained.

1. Communication converters - due to their relatively large mass and power consumption and past operational reliability, compared to the absence of power to power sources, they are used as current converters for asynchronous motor reactive power and control systems. This creates a number of dangers and inconveniences.

2. Magneto-galvanic converters - the power consumption of our main consumer asynchronous motor cannot be fully operated.

3. Electromechanical measuring sensors - the errors are high power consumption and uneven shape, the current transformer is connected in series to the consumer, there is a common size.

4. The output current values of current transformers are 1 A and 5 A. Current transformers have three main parts - the primary winding, the magnetic circuit and the secondary winding. They are signal conversion, and file errors are checked for accuracy based on the direct origin of the recording.

Method. The main part. Based on the above analysis, we propose a current-to-voltage converter to monitor and control the active and reactive power consumption of asynchronous motors, which are the main consumers of renewable energy sources, and is shown in Figure 1.
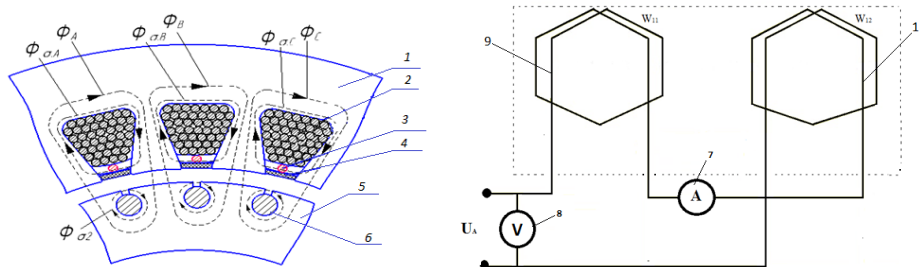
Figure 1

In the figure, we have placed a sensor element between the stator blades of an asynchronous motor that consumes alternating current, and we have given a diagram of its internal view and a schematic view of the sensor element. 1 - fixed part - stator, 2 - stator windings, 3 - measuring sensitive element, 4 - insulating wedge, 5 - rotating part of the rotor, 6 - rotor windings, 7 - ammeter, 8 - voltmeter, 9-10 - sensitive element .

As can be seen from this figure, the primary current IA of one phase of the stator winding of an asynchronous motor is converted into the secondary voltage Ua in the measuring circuit W1, which consists of two independent circuits W11 and W12, and transmits the received signal. controller, to the controller We transfer the information and allow the controller to process the data. When the asynchronous motor is connected to the network, the output voltage Ua is determined by the voltage of one independent measuring circuit W11 as follows:

$$U_{a\Sigma} = U_a = U_1 = \left(4{,}44 \cdot f \cdot W_{c1} \cdot \frac{I_A}{R_\mu}\right) W_{11}$$

Here f is a set of frequencies.

W_{A1} - the number of turns of the stator windings of phase A of the asynchronous motor

W_{11}-W_{22} -induction motor measuring tapes.

W_{22} - as a result of the current passing through the coil, the main F1 and stray magnetic fluxes Fc1 are formed.

$$\Phi_1 = \frac{1}{4.44 f W_{11}} U_1$$

$$\Phi_{\sigma 1} = \frac{L_{\sigma 1.8} I_1}{W_{11}}$$

The main and shunt magnetic fluxes cross the gauge lobes, creating an EMF in the coil, and we can look at its formula to find E1.

$$E_1 = \sqrt{2}\pi f w_{11} \frac{1}{\sqrt{2}\pi f w_1}(I_1 - Z_1 I_1) = \frac{U_1 - Z_1 I_1}{k_w}$$

In the figure below, we can see the situation where we obtained the output signal of our sensing element when changing the loads on phases 1 and 3 of our 250 kVA asynchronous motor under modern laboratory conditions.

Figure 2

In the picture, we can see the laboratory stand and measuring equipment of a consumer asynchronous motor device from an alternative energy store.

In our experimental current transformer, the primary current changes and the current control of the induction motor are generated by the magnetic flux of the stator coils based on the magnetic flux, two independent sense coil loops control the stray magnetic flux between the phases through the controller. contacts. They are connected separately, and as a result, below we can see the static characteristic of the output voltage of the measuring sensitive loops.

In our experimental current transformer, the primary current changes and the current control of the induction motor are generated from the magnetic flux of the stator coils based on the magnetic flux, two independent sense coil loops control the stray magnetic flux between the phases through the controller contacts. . are connected separately and as a result below we can see the static characteristic of the output voltage of the measuring sensitive loops.

Results. We can see the theoretical form of the static description of the output currents and the output signal of the induction motor obtained in the experiment.
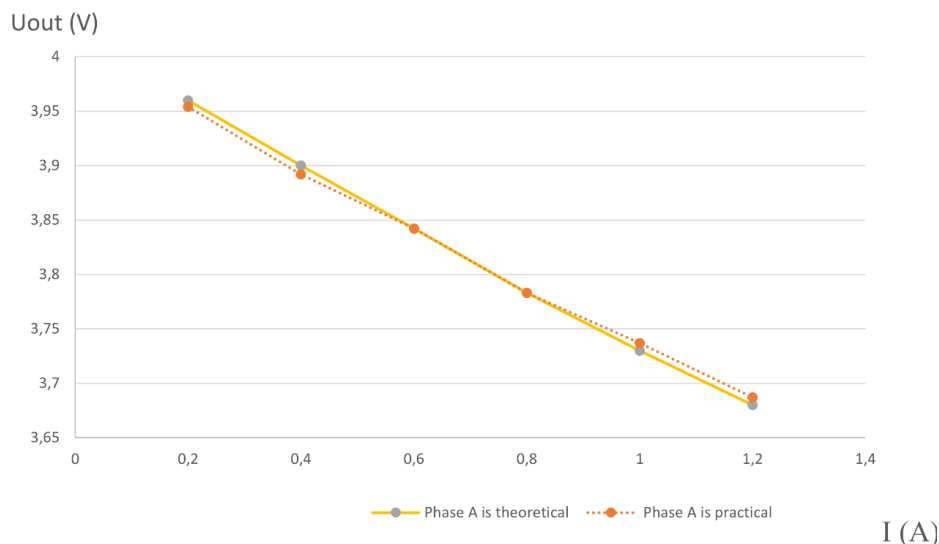
Figure 3.1
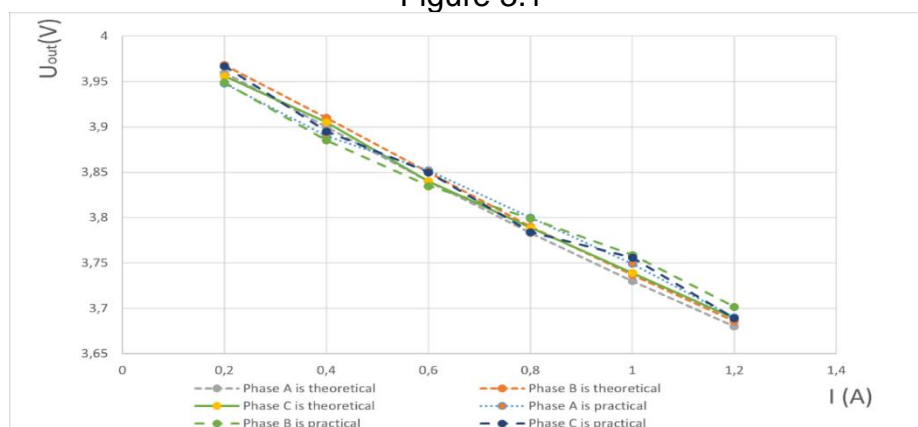
Figure 3.2

3.1,3.2- The figure shows the static characteristic of the output voltage in one phase and three phases of the current transformer placed between the stator wedges and the insulating wedge of the asynchronous motor, the output characteristic is close to a straight line.

$$\Delta U_{A\,out} = \frac{U_{pract} - U_{theor.}}{U_{pract}} = \frac{3,85 - 3,84}{3,85}\,100\% = 0,2\%$$

Below we can see the theoretical values and practical results of the appearance of the output signals obtained in the caysilab program for the static description of the induction motor.

$$\Delta U_{nosim\,katt} = \frac{\Delta U_{Achiq} + \Delta U_{Bchiq} + \Delta U_{Cchiq}}{U_{amaliy}} = \frac{0,2 + 0,5 + 0,04}{3}\,100\% = 0,7\%$$

Discussions. From the obtained results, it can be seen that the recommended current converter is better than the previous ones due to its higher accuracy class, reliability, compact form, and full and fast delivery of information.

Conclusion. The power losses of currently used motors are increased during overloading or after overhaul. Taking into account that certain asynchronous motors are the most common motors, their control and management are urgent problems, and the proposed method is effective, and our current The static characteristic of our transformer is linear, so we recommend it for its simplicity, precision, compactness and other characteristics, and it is suitable for the environment of our country.

References

1. Siddiqov I. X. Boyxonov Z. U. Karimjonov D. D. Elements And Devices For Monitoring And Controlof Energy Efficiency. The American Journal of Engineering and Technology (ISSN – 2689-0984) Published: September 29, 2020 | PaGES: 136-148.

2. Siddiqov I. X., Boyxonov Z. U, Maxsudov M. T., Uzoqov. R. Features productions reactive power onsystems electrical supply with renewable sources energies. Academicia: an international multidisciplinary research journal vol. 10, issue 6, June 2020 PaGES: 292-29.

3. Махсудов М. Т. Бойхонов З. У. Исследование электромагнитных преобразователей тока в напряжение // Бюллетень науки и практики. 2018. Т. 4. №3. С. 150-154. Режим доступа: http://www.bulletennauki.com/mahsudov (дата обращения 15.03.2018)

4. Эгамов, Д. А. Эффективность применения «переносного АВР-0,4 кВ» для обеспечения бесперебойного электроснабжения потребителей / Д. А. Эгамов, Р. Узаков, З. У. Боихонов // Исследования и разработки в области машиностроения, энергетики и управления : материалы XIX Междунар. науч.-техн. конф. студентов, аспирантов и молодых ученых, Гомель, 25–26 апр. 2019 г. / М-во образования Респ. Беларусь, Гомел. гос. техн. ун-т им. П. О. Сухого; под общ. ред. А. А. Бойко. – Гомель: ГГТУ им. П. О. Сухого, 2019. – С. 250-253.

5. Эгамов Д. А., Узаков Р., Бойхонов З. У Способы обеспечения бесперебойного электроснабжения потребителей, имеющих одну систему шин 6-10 кВ и два независимых источника питания 6-10 кВ // Бюллетень науки и практики. 2018. Т. 4. №3. С. 155-159. Режим доступа: http://www.bulletennauki.com/egamov-uzakov (дата обращения 15.03.2018).

6. Сиддиков И. Х., Махсудов М. Т., Боиханов З. У. угли, Схема замещения и анализ работы асинхронного двигателя при потреблении реактивной мощности. Главный энергетик №7 2021. 2021;7.

7. Махсудов М.Т., Анарбаев М.А., Сиддиков И.Х. Электромагнитные преобразователи тока для управления источниками реактивной мощности // Universum: Технические науки: электрон. научн. журн. 2019. № 3(60). URL: http://7universum.com/ru/tech/archive/item/7095

8. I.Kh. Siddikov, A.B. Abubakirov, A.A. Yuldashev, G.Z. Babaxova, I.M. Xonturaev, N.N. Mirzoev. «Methodology of calculation of techno-economic indices of application of sources of reactive power». European science review, Scientific journal. No 1–2. Austria, Vienna. 2018. 248-251 p.

9. I.Petrova, V. Zaripova, Yu. Lezhnina, I.Kh.Siddikov. Automated system for synthesis of sensors for smart cities. XXII International Scientific Conference on Advanced In Civil Engineering "Construction the formation of living environment', Tashkent, Uzbekistan, 18-21 April, 2019 E3S Web of Conferences eISSN: 2267-1242. https://www.scopus.com/record/display.uri?eid=2-s2.085067281218&origin=resultslist

10. Сиддиков И. Х., Анарбаев М. А., Махсудов М. Т. Преобразователи сигнала величины тока для систем управления источниками реактивной мощности // Инженерно- строительный вестник Прикаспия: научно-технический журнал / Астраханский государственный архитектурно-строительный университет. Астрахань: ГАОУ АО ВО «АГАСУ», 2018. № 1 (23). С. 53–56.

11. Siddikov I. Kh., Khakimov M. Kh., Anarbaev M., Bedritskiy I. M. Research of the electromagnetic transducers of the primary current to secondary voltage // Science and Education. Materials of the II International Research and practice conference. Vol. I,

Publishing office of «Vela Verlag Waldkraiburg», Munich. Germany. December. 18–19. 2012. P. 222–225.

12. Siddikov I.K., Sattarov Kh.A., Khujamatov Kh.E., Dekhkonov O.R. Agzamova M. Modeling of Magnetic Circuits of Electromagnetic Transducers of the Three-phases Current //2018 14th International Scientific - Technical Conference On Actual Problems of Electronic Instrument Engineering (Apeie) Proceedings. In 8 Volume Part 5 Novosibirsk 2018;

13. Сиддиков И.Х., Аъзамов С.С., Тожибоев Ж.Б. Возобновляемый источник энергии систем электроснабжения истраченной реактивной мощностью и управление элементарным улучшением / Siddikov I.H.,

14. Azamov S.S., Tozhiboev Zh.B. Renewable energy source of power supply systems with expired reactive power and management of elementary improvemen Просвещение и познание 2022. № 9 (16) научно-методический журнал ст-3-10.

15. Modelling of the asymmetrical quantities of asynchronous motors reactive powers supply on the basis of current transdusers Siddikov Ilkhomjon Xakimovich, Boikhanov Zailobiddin Urazalai oʻgʻli, Aʼzamov Saidikrom Saidmurodovich// Andijon mashinasozlik instituti mashinasozlik ilmiy-texnika jurnali varoq-143-152.

16. Rustam Baratov 1 , Nurali Pirmatov2 , Abdullo Panoev3 , Yakubjon Chulliyev1 , Sodiq Ruziyev1 and Almardon Mustafoqulov1 Achievement of electric energy savings through controlling frequency convertor in the operation process of asynchronous motors in textile enterprises// This content was downloaded from IP address 213.230.96.54 on 29/03/2023 at 08:14

17. A M Safarov[1], Kh A Sattarov[2], A M Mustafoqulov[3] and Yu Yu Shoyimov[4]Experimental research of magnetic circuits of current converters taking into account the nonlinearity of magnetic characteristics// A M Safarov *et al* 2022 *J. Phys.: Conf. Ser.* **2176** 012006

18. D D Karimjonov, I X Siddikov, S S Azamov, and R Uzakov, Study on determination of an asynchronous motor's reactive power by the current-to-voltage converter. IP address 213.230.96.54 on 23/03/2023 at 07:07

19. Сиддиков И.Х., Махсудов М.Т., Боихонов З.У.. Асинхрон моторнинг реактив кувват истеъмолини назорат ва бошкариш тизими ток ўзгарткичлари // «Илм–фан, таълим ва ишлаб чикаришнинг инновацион ривожлантиришдаги замонавий муаммолар» мавзусида ҳалқаро илмий–амалий конференция, Андижон 13 – 15 май 2020 йил, 481 – 485 бетлар.

20. "Qisqacha politexnik lugʻat". Oʻzbekiston ensiklopediyasi bosh tahririyati. T. Fan. 1992 y. 137-142c

21. Siddikov I.X., Anarboev M.A.,Mirzaev N.N., Mamatqulov A.N., Statik va dinamik reaktiv quvvat manbalarini boshkaruv elementlari // Energiya va resurs tejash muammolari // Ilmiy jurnal (maxsus nashr) Toshkent 2013 № 3–4 39-42 б.

EVALUATION AND DEVELOPMENT OF DIAGNOSTICS OF THE CRANKSHAFT OF DIESEL LOCOMOTIVES

KUDRATOV SHOHIJAKHON

Doctoral student of Tashkent State Transport University
E-mail: kudratov.shohijaxon@bk.ru, phone: (+99890) 788-85-83

Abtract. A significant increase in the efficiency of the equipment used is achieved through the introduction of modern methods and means of technical diagnostics. Technical diagnostics makes it

possible to increase the overhaul life of units and assemblies, prevent the dismantling and disassembly of units and individual mechanisms, reduce downtime for technical reasons, reduce the labor intensity of maintenance and operating costs, which significantly increases the efficiency of the use of equipment. Technical diagnostics makes it possible to control the technical condition of machines during operation and predict their service life until the next repair in accordance with the indicators obtained. It allows not only to assess the technical condition of the units and assemblies of machines, but also makes it possible to determine the volumes and types of necessary work using in-place methods. The main tasks of technical diagnostics are: control of the technical condition for compliance with the requirements of technical documentation; search for the causes of failure (malfunction); collection of initial data for forecasting the technical condition; maintaining machine reliability.

Keywords: diesel, crankshaft, diagnostics, operation, overhaul, lubrication, cleanliness.

Introduction. To maintain locomotives in working condition, to prevent gradual failures due to aging and wear of equipment, a smoothly preventive system of repairs is needed. It includes a set of interrelated provisions and standards that determine the organization and procedure for the maintenance and repair of rolling stock. The advantage of this system is the ability to guarantee the established resource and safe operation of the most important units and parts of the diesel locomotive.

The main disadvantage of the system is the high level of costs for the production of a specified amount of work for a given type of maintenance or repair. However, despite the large material costs, the use of a preventive system is advisable to ensure a high level of safety and guarantee reliability in terms of serviceability for a strictly defined period of operation of the locomotive fleet.

Research method. An example of a research method is the malfunctions that occur during operation. When overhauling the engine, especially after grinding the crankshaft, many do not attach importance to the cleanliness of the crankshaft oil channels, clean them correctly. This operation is also very important because when grinding the crankshaft to the repair size of the liners, abrasive and processing products (metal dust) get into the oil channels. If after that you do not thoroughly rinse the oil channels of the crankshaft, then at the first start of the engine, the remaining dirt can do a lot of trouble, at best, it will simply greatly reduce the life of the engine. Therefore, thorough flushing of the internal cavities of the crankshaft is very important. The crankshaft oil channels, in addition to their function of supplying oil to friction pairs (crankshaft journals and liners), also serve to trap dirt particles (in special cavities) that can pass through the filter (very small particles) using centrifugal force. There were times when dirt completely clogged the oil channels, and from this, naturally, friction pairs began to work dry and quickly failed.

Oil starvation of the engine leads to irreversible consequences - in addition to penny liners, the crankshaft is damaged. And it often happens that the seizures on the crankshaft remain larger than the last repair size, and this is the purchase of a new expensive part. Oil starvation of the engine does not mean that there is no oil at all, it just wasn't enough for some parts due to the low level, low throughput of the lubrication system due to clogging or other reasons. Not necessarily the entire engine does not receive oil - most often there is not enough oil in individual engine components.

Consequences of engine oil starvation. For example, when the crankshaft rotates, it does not come into contact with the liners, there is always oil between them, the so-called oil wedge. But when there is not enough oil, it stops flowing to the crankshaft and liners, then this oil wedge disappears and the shaft begins to rub against the liners and the shaft wedges due to friction and the resulting temperature increase, but since it continues to rotate by inertia, this wedge breaks, the more thereby tearing out the surface layer of metal from both surfaces. The result is an insert in foil, deep scuffs on

the crankshaft. If the oil pressure methodically gradually begins to decrease in the system, that is, it passes through the pipeline less, the connecting rod bearings of the crankshaft will suffer first of all, since they are located the farthest and the oil approaches them according to the residual principle. One of the most important elements of the internal combustion engine is the crankshaft. Due to it, energy from fuel combustion can be transferred to adjacent elements and ensure the rotation of the wheels. Responsible for reducing friction losses and preventing the wedge of parts at the point of contact of the crankshaft with the engine block bed (main bearings) and piston rods (rod bearings).

• **Indigenous.** Such liners are located between the shaft itself and the places where it passes through the engine housing;

• **Connecting rod.** They are installed between the connecting rods and the crankshaft journals.

Results. One of the important tasks is to improve the diagnostic method of the crankshaft. D49 diesels were used in diagnostics. A thermal sensor is installed on the connecting rod and root joints of the crankshaft. The oil has protection against this, but it does not signal a crankshaft failure. Thermosensor DS18B20 is used for this. Basic functional options DS18B20 is a temperature converter. The resolution of the temperature converter can be changed by the user and consists of 9, 10, 11, or 12 bits, corresponding to 0.5 °C, 0.25 °C, 0.125 °C, and 0.0625 °C, respectively.

Resolution is set to 12-bit by default. In the initial state, the DS18B20 is in a dormant state (in an inactive state). To start temperature measurement and conversion, the master must issue the start temperature conversion command [0x44]. After conversion, the received data is stored in a 2-byte register temperature in RAM, and the DS18B20 returns to the inactive state. If the DS18B20 is switched on with external power, the master can control the temperature conversion (after command [0x44]) according to the bus status. The DS18B20 will generate (response to the read time slot from the controller) logic "0" when a temperature conversion occurs. And a logical "1" when the conversion is done. If the DS18B20 is enabled with parasitic power, this notification technology cannot be used because the bus must be driven high (supply voltage) for the duration of the temperature conversion. In this case, the control device must independently control the conversion time. The DS18B20 temperature output is calibrated in degrees Celsius. The temperature data is stored as a 16-bit signed number. The flag (S) bits indicate whether the temperature is positive or negative: for positive numbers, S = 0, and for negative numbers, S = 1. If the DS18B20 is configured to convert 12-bit resolution, then all bits in the temperature register will contain valid data. For 11-bit resolution, bit 0 is undefined. For 10-bit resolution, bits 1 and 0 are undefined, and for 9-bit resolution 2, 1 and 0 are undefined.
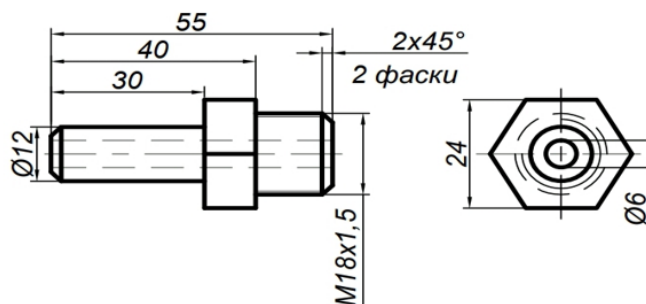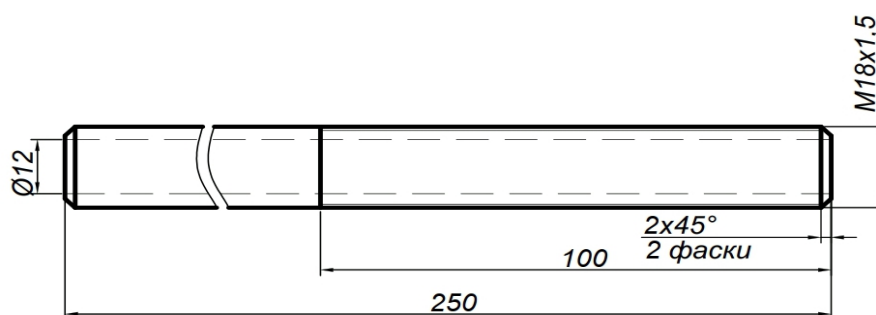
Figure 1. DS18B20 Mounting Tool and Signal Processing via Microcontroller

Conclusion. The thermosensor DS18B20 is installed on the crankcase cover, as a result, it reports the temperature of the coolant coming out of the crankshaft. The signal from the sensor is sent to the microcontroller, as a result of which the signal is processed and displayed as a number. This makes it possible to diagnose the crankshaft of diesels. As a result, a diagnosis is made, the bearings are checked, the oil channels are inspected, or the high-pressure fuel pumps are inspected and their technical standards are checked. To extend the life of the crankshaft, change the oil in a timely manner, choose high-quality oil filters and change them at the same time as changing the oil. Periodically carry out a visual inspection for diesel oil leakage, to prevent engine overheating. Monitor the condition of the cylinder cover to prevent water and fuel from getting into the diesel oil. DS18B20 it was found that the work on the creation of methods and means of technical diagnostics should be carried out in the direction of reducing labor intensity, improving the quality and efficiency of the obtained diagnostic information about the technical condition of the object being diagnosed. It is advisable to create diagnostic systems taking into account the modular basis, since it becomes possible to create additional functions and diagnostic capabilities by introducing an additional module into the system.

References

1. Khamidov, O.R., Grishchenko, A.V. Locomotive asynchronous traction motor rolling bearing fault detection based on current intelligent methods Journal of Physics: Conference Series, 2021, 2131(4), 042084

2. Grishchenko, A.V., Kruchek, V.A., Kurilkin, D.N., Khamidov, O.R. Diagnostics of the Technical Condition of Rolling Bearings of Asynchronous Traction Motors of Locomotives Based on Data Mining Russian Electrical Engineering, 2020, 91(10), pp. 593–596

3. Valiev M. Sh. Application of a sensor to control the quality of the working process of a diesel locomotive / M. Sh. Valiev. - Locomotives. Gas motor fuel (Problems. Solutions. Prospects): Proceedings of the I International Scientific and Practical Conference. Samara, June 29, 2016 - 01 2017 - 2016. - p.69 - 73.

4. Valiev, M. Sh. Diagnostics of the working process of a diesel locomotive under operating conditions / M. Sh. Valiev. - Bulletin of Transport of the Volga Region. Samara State University of Communications. Samara - 2011. - No. 1 (25). – p.35 – 39. 317

5. Ablyalimov, O., Petrochenko, S., Kodirov, N. Analyzing the Movement of a Freight Train at Stops on Flat Sections of the Railway Lecture Notes in Networks and Systems, 2023, 510, pp. 165–171

6. Grachev, V. V. Assessment of the technical condition of diesel cylinders using an oxygen content sensor in exhaust gases / V. V. Grachev, M. Sh. Valiev // News of PGUPS

/ St. Petersburg State University of Railway Transport. - St. Petersburg. - 2011. - No. 2 (27). - With. 25 - 32.

7. Mamayev, S., Fayzibayev, S., Djanikulov, A., Kasimov, O. Method of Selection of Mainline Locomotives in the Unloaded State According to the Speed Characteristics Affecting the Electromechanical Vibrations of the WMB AIP Conference Proceedings, 2022, 2432, 030105

8. Valiev M.Sh., Kosimov Kh.R., Kudratov Sh.I. Evaluation of the technical condition of the diesel by working process parameters pp.312-317: In the collection: Technological support for the repair and improvement of the dynamic qualities of railway rolling stock. Materials of the V All-Russian scientific and technical conference with international participation. 2019. P. 312-317.

9. Valiev M.Sh. Diagnostics of crankcase oil flooding and protection of diesel engines from its impact in the collection: transport: science, education, production. collection of scientific papers. 2019. S. 253-256.

10. Valiev M.Sh. Evaluation of the technical condition of diesel cylinders using the sensor of the oxygen content in the exhaust gas In the collection: The future of mechanical engineering in Russia. Collection of reports of the Tenth All-Russian Conference of Young Scientists and Specialists (with international participation). 2017. S. 493-496.

11. Valiev M.Sh. Use of oxygen content sensor for control of excess air ratio of diesel Transsib News. 2017. No. 2 (30). pp. 9-17.

12. Valiev M.Sh.Use of a sensor for quality control of the diesel engine operation process Valiev M.Sh. In the collection: Locomotives. Gas fuel 2 (Problems. Solutions. Prospects). Materials of the I International Scientific and Practical Conference. 2016. S. 69-73.

13. Valiev M.Sh. Increasing the efficiency of diesel locomotives with the help of on-board diagnostics systems Valiev M.Sh. dissertation for the degree of candidate of technical sciences St. Petersburg State University of Communications. St. Petersburg, 2011

14. I.F.Pushkarev, E.A. Paxomov Control and assessment of the technical condition of diesel locomotives transport publishing house

15. Investigation of circular oscillations in the start mode of diesel locomotive UZTE16M. Dzhanikulov A.T., Valiev M.Sh. / News Transsib. 2021. No. 3 (47). P. 23-30.

16. Grachev VV, Bazilevskiy F.Yu., Valiev M.Sh. Device for control of excess air coefficient of diesel engine Proceedings of the Petersburg University of Communications. 2011. No. 3 (28). pp. 153-162.

17. Khamidov O., Kudratov Sh. Integral assessment of the technical condition of power plant systems of locomotives, International conference on "Language and cultures: Prospects for Development in the 21st Century" pp 165-168.

18. Khamidov O., Kudratov Sh. Evalution of the thermal state of a cylinder – piston groups of diesel type D49, Academic research in modern science International scientific-online conference. pp 72-79.

19. Valiev M.Sh. Increasing the efficiency of on-board diagnostics systems on diesel locomotives abstract of the dissertation for the degree of candidate of technical sciences St. Petersburg State University of Communications. St. Petersburg, 2011

20. Valiev M., Kosimov K. Diagnostics of the technical condition of the cylinder-piston group of diesel In the collection: E3S Web of Conferences. Sep. "International scientific conference "Construction mechanics, Hydraulics and Water resources engineering, CONMECHYHDRO 2021" 2021

A NEW KEY STREAM ENCRYPTION ALGORITHM AND ITS CRYPTANALYSIS

KHUDOYKULOV ZARIF

Department of Cryptology, Tashkent University of Information Technologies named after Muhammad Al-Khwarizmi
E-mail: zarif.xudoyqulov@mail.ru

RAKHMATULLAEV ILKHOM

Samarkand branch of Tashkent University of Information Technologies named after Muhammad al-Khwarizmi
E-mail: ilhom9001@mail.com

Abstract. The new stream encryption algorithm (NSA-New Stream Algorithm) is proposed in this work. The input parameters are considered a 128-bit secret key and 128-bit initialization vectors in the new algorithm. A 64-bit line is generated in each round as the output value. The architecture of the algorithm is particularly suitable for efficient hardware implementations, together with this, this algorithm is also suitable for software implementation. On the other hand, the security was evaluated for resynchronization attack, related key attack, and attack methods on the basis of linear correlation of the output sequence. Analysis confirms that this algorithm is a secure stream encryption algorithm.

Keywords. Linear Feedback Shift Registers (LFSR), Output Sequence Randomization, Resynchronization Attack, Related Key Attack, Linear Crypto analysis, Differential Crypto analysis, Integral Crypto analysis

Introduction. Several approaches to the design of pseudo-random number generators which can be used in stream encryption algorithms are known from the literatures. One of the popular approach is based on Linear Feedback Shift Registers (LFSR). They are suitable for very compact hardware applications and provide good randomness. However, due to their linearity and approximation, they cannot be used in pure forms. Several techniques have been developed in order to ensure their security, such as a combination generator, nonlinear filtering, and clock control. Numerous researches have been conducted to ensure the safety of these schemes. However, generators which are created on the basis of LFSR are not suitable for effective software implementation of algorithms which are developed on the basis of them.

On the other hand, software-oriented stream ciphers seem to be custom-designed, and we don't have the proper tools to evaluate them. The most important criterion is considered to check for deviations from randomness.

The algorithm made for security reasons is evaluated for its tolerance against resynchronization attacks and related key attacks.

In addition, the linear correlation of the output sequence was calculated.As a result, it was concluded that this algorithm is a reliable and effective cryptographic tool which can be used to provide encryption and message authentication.

From this point of view, the development of new stream encryption algorithms on the basis of a new approach is considered one of the actual researches.

The main part. The following new streamen cryption algorithm is proposed by analyzing existing stream encryption algorithms and generators,

Markings:

K –secret key;

I –initialization vector;

K_0–thefirst 64 bits of the key;

K_1–thesecond 64-bits part of the key;
I_0–thefirst 64-bits part of the initialization vector;
I_1–thesecond 64-bits part of the initialization vector;
x –length 64 bits array;
a_0, a_1, a_2–status arrays with a length of 64 bits;
$b - 16$ $(b_0, b_1, \ldots, b_{15})$ buffer arrays with a length of 64 bits;
T –update function;
p –mixing (updating the state of arrays) function;
F –non-linear function in the mixing function;
λ –update function of $b$buffer value;
C_0, C_1, C_2, C_3, C_4 - constant numbers (constant values);
S - non-linear reflection (byte replacement - block);
M – linear reflection (matrix multiplication);
L -byte swapping function.

Input information:
Plain text: 64 bits;
Private key: 128 bits;
Initialization vector (I): 128 bits;
T –update function:

$$(a^{t+1}, b^{t+1}) = T(a^t, b^t) = (p(a^t, b^t), \lambda(a^t, b^t))$$
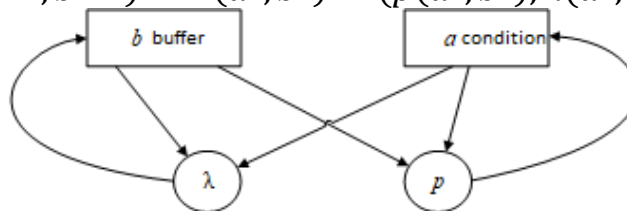
Figure 1. The schematic view of T - update function

p –mixing function:

$$a_0^{(t+1)} = a_1^{(t)} \oplus C_0$$
$$a_1^{(t+1)} = a_2^{(t)} \oplus F(a_1^{(t)}, b_4^{(t)} \lll 15) \oplus C_1$$
$$a_2^{(t+1)} = a_0^{(t)} \oplus F(a_1^{(t)}, b_{10}^{(t)} \lll 15) \oplus C_2$$
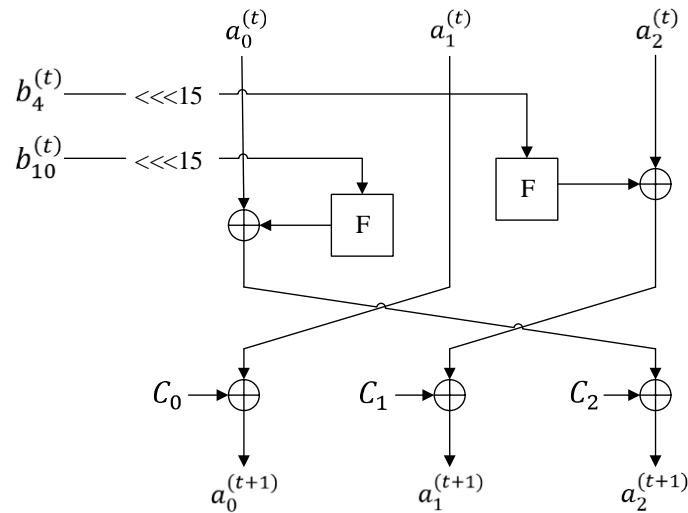
Figure 2. The schematic view of the p –mixing function

F function:

$$F(a_1^t, o) = L(M(S(a_1^t \oplus o)))$$
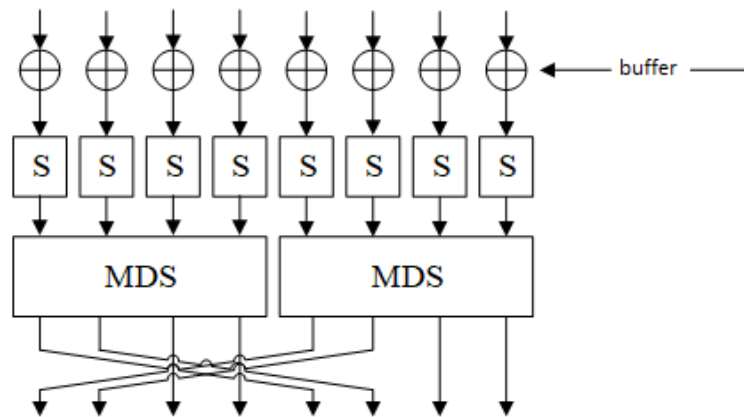
Figure 3. The schematic view of the F function

L function:

$$L(x_0, x_1, x_2, x_3, x_4, x_5, x_6, x_7) = x_4||x_5||x_2||x_3||x_0||x_1||x_6||x_7,$$

λ, function

$$b_{15}^{t+1} = a_1^t \oplus C_0$$
$$b_{14}^{t+1} = a_1^t \oplus F(b_{15}^t, 0) \oplus C_1$$
$$b_{13}^{t+1} = a_0^t \oplus a_2^t \oplus b_{14}^t \oplus F(b_{14}^t, 0) \oplus C_2$$
$$b_{i}^{t+1} = a_0^t \oplus a_1^t \oplus a_2^t \oplus b_{i+1}^t \oplus b_{i+2}^t \oplus F(b_{i+1}^t, 0) \oplus C_3$$
$$i = 12, 11, \dots, 0.$$

S non-linear reflection:

[fc, ee, dd, 11, cf, 6e, 31, 16, fb, c4, fa, da, 23, c5, 4, 4d, e9, 77, f0, db, 93, 2e, 99, ba, 17, 36, f1, bb, 14, cd, 5f, c1, f9, 18, 65, 5a, e2, 5c, ef, 21, 81, 1c, 3c, 42, 8b, 1, 8e, 4f, 5, 84, 2, ae, e3, 6a, 8f, a0, 6, b, ed, 98, 7f, d4, d3, 1f, eb, 34, 2c, 51, ea, c8, 48, ab, f2, 2a, 68, a2, fd, 3a, ce, cc, b5, 70, e, 56, 8, c, 76, 12, bf, 72, 13, 47, 9c, b7, 5d, 87, 15, a1, 96, 29, 10, 7b, 9a, c7, f3, 91, 78, 6f, 9d, 9e, b2, b1, 32, 75, 19, 3d, ff, 35, 8a, 7e, 6d, 54, c6, 80, c3, bd, d, 57, df, f5, 24, a9, 3e, a8, 43, c9, d7, 79, d6, f6, 7c, 22, b9, 3, e0, f, ec,

de, 7a, 94, b0, bc, dc, e8, 28, 50, 4e, 33, a, 4a, a7, 97, 60, 73, 1e, 0, 62, 44, 1a, b8, 38, 82, 64, 9f, 26, 41, ad, 45, 46, 92, 27, 5e, 55, 2f, 8c, a3, a5, 7d, 69, d5, 95, 3b, 7, 58, b3, 40, 86, ac, 1d, f7, 30, 37, 6b, e4, 88, d9, e7, 89, e1, 1b, 83, 49, 4c, 3f, f8, fe, 8d, 53, aa, 90, ca, d8, 85, 61, 20, 71, 67, a4, 2d, 2b, 9, 5b, cb, 9b, 25, d0, be, e5, 6c, 52, 59, a6, 74, d2, e6, f4, b4, c0, d1, 66, af, c2, 39, 4b, 63, b6].

Constants:

$C_0 =$ 0x6a09e667f3bcc908,

$C_1 =$ 0xbb67ae8584caa73b,

$C_2 =$ 0x3c6ef372fe94f82b,

$C_3 =$ 0xa54ff53a5f1d36f1,

$C_4 =$ 0x510e527fade682d1.

M line arreflection:

This reflection represents a 32-bit MDS matrix multiplication operation in the Rijndael algorithm. (x_0, x_1, x_2, x_3) and (y_0, y, y_2, y_3) represent the input and output matrices of the reflection:

$$y_0 = 0x02 \cdot x_0 \oplus 0x03 \cdot x_1 \oplus 0x01 \cdot x_2 \oplus 0x01 \cdot x_3,$$
$$y_1 = 0x01 \cdot x_0 \oplus 0x02 \cdot x_1 \oplus 0x03 \cdot x_2 \oplus 0x01 \cdot x_3$$
$$y_2 = 0x01 \cdot x_0 \oplus 0x01 \cdot x_1 \oplus 0x02 \cdot x_2 \oplus 0x03 \cdot x_3$$
$$y_3 = 0x03 \cdot x_0 \oplus 0x01 \cdot x_1 \oplus 0x01 \cdot x_2 \oplus 0x02 \cdot x_3$$

Initialization. The initialization process consists of 3 steps. In the first step, the arrays of b buffer is initialized using the K key, and in the second step, the buffer arrays of a_0, a_1, a_2 state is initialized using I initialization vector. In the third step, the internal state arrays are mixed.

Step 1: The 128-bit key is expanded to 192 bits and a_0, a_1, a_2 written to state arrays:

$$a_0^{t_0} = K_0, a_1^{t_0} = K_1, a_2^{t_0} = (K_0 \lll 11) \oplus (K_1 \ggg 11) \oplus C_4$$

Here, t_0 indicates that the initialization processss has started.

After that, the values on the left side of a_1^t are shuffled using the $p-$ shuffle function. a_0^t is placed into the array buffer as follows:

$$b_{15-i} = (p^{i+1}(a^{(t_0)}, 0))_0$$

here $p^i p$ denotes the $i-$ iteration of the function. $p(a, 0)$ means that the values in the b buffer are not used at this stage.

Step 2: In this step, $a(K) = p^{16}(a(K, I), 0)$ state arrays and I- initialization vector are required. I –the initialization vector is added to the a state arrays as follows:

$$a(K, I)_0 = a(K)_0 \oplus I_0 \oplus C_4 ,$$
$$a(K, I)_1 = a(K)_1 \oplus I_1 \oplus C_4,$$
$$a(K, I)_2 = a(K)_2 \oplus (I_0 \lll 11) \oplus (I_1 \ggg 11) \oplus C_4$$

a state arrays are mixed 16 times by repeating the p function Then this process can be expressed as $p^{16}(a(K, I), 0)$.

Step 3. In the last step, the T update function is repeated 16 times. This process can be described as follows:

$$a^{(1)} = T^{16}(p^{16}(a(K, I), 0), b(K))$$

Here, $b(K)$ is a K key-initialized array buffer.

After initialization, the algorithm generates 64-bit random numbers and changes the internal state in each iteration. The output of cycle is taken as Output[t], the output vector is defined as follows:

$$exit[t] = a_2^{(t)}$$

In other words, the algorithm outputs the rightmost 64 bits of the a state arrays each time. After that, step 3 of the initialization process is performed again.

The steps from initialization to random number generation are shown in Table 1:

Table 1.

Representation of the algorithm process in a tabular form

	t round	process	input	output
Initialization	-49	Input the key		-
	-48, …, -33	Mixing by using function P	-	-
	-32	Input IV		
	-31, …, -16	Mixing by using function P	-	
	-15, …, 0	Mixing by using function	-	
Generation of a byte array	1,…	Mixing and output	-	output[t]

Evaluation results of the NSA algorithm to cryptanalysis methods. The security of an algorithm depends on the relationship between the input and output bits (or the relationship between the output bits). The internal state complete key selection attack, or attacks that facilitate the complete key selection attack applied to stream encryption algorithms, exploit some of these relationships and predict the internal state. It is assumed that the parser can observe some deviation between input and output bits (or only between output bits) and obtain information about the internal state, even if it cannot do so. This stems from the philosophy that it should be impossible to predict the output sequence of a secure pseu-dorandom number generator. Theafore mentioned relationships are divided into three cases:

Randomization of the output sequence. The parser observes changes in the output sequence by changing the secret key and the initialization vector.

Resynchronization attack. The parser observes the relationship between the initialization vector and the output sequences by changing the secret key.

Related key attack. The parser observes the relationship between the keys and the output sequence by changing the initialization vector. This attack involves tracking the relationship between the keys and the initialization vector [7].

On the other hand, the exhaustive key search requires an average of 2^{127} computations to find a valid key. The attack is considered successful if consumesless resources are used than the average of 2^{127} key selections.

Randomization of the output sequence.

Linearity should be one of the most important properties of certain estimation methods. Here, "linearity" does not mean linear complexity, but rather the maximum likelihood of linear combinations of output bits. It should be noted that the search for a linear combination is similar to the search for the best guess for a block cipher and uses the evaluation method used in linear cryptanalysis [5]. More precisely, this algorithm corresponds to the calculation of

150

active S-boxes in line arapproximations to estimate the linearity of the output sequence. However, applying this method to pseudo-random number generators is more difficult than applying it to block cipher algorithms, since the buffer is updated dynamically. Therefore, it is more efficient to calculate a lower bound on the number of active S-boxes needed for any linear approximation than to construct actual linear approximations.

The number of active S-boxes of line arapproximation is denoted by AS. The maximum linearity probability of the S-box of the proposed NSA algorithm is 2−6, so if there is not linear approximation with AS<22, it can be assumed that the linearity of the output sequence of the algorithm is small enough. Applying this method to the proposed NSA algorithm, the following theorem was established:

Theorem. The linear approximation of the NSA algorithm is AS ≥22.

The proof of this theorem is given in the following. The construction of a linear approximation consisting of output units is divided into two steps as follows:

1. Construction of linear approximations of p

2. Search for the path containing the buffer.

Construct linear approximations of p. Before starting the evaluation, the equivalent variants of p are selected for ease of analysis. Figure 4 shows the modified options of the transformation. The F function on the left is marked with a G function; These designations are used for convenience only. Firstly, F can be moved to the left in the next step. Then, the mask corresponding to the output unit can accept all values, so we divide this part into two masks, the output mask is the input mask. This transformation is not equivalent in the general sense, but it is equivalent in the sense that the mask templates do not change with the transformation. After that, we remove unnecessary links. The right side of Figure 4 shows a modified version of the p function. Then "p" means changed p. Note that the number of bindings is reduced by two, and the output masks of the F- and G-functions come directly from the "input" and "output" masks that the parser can choose.
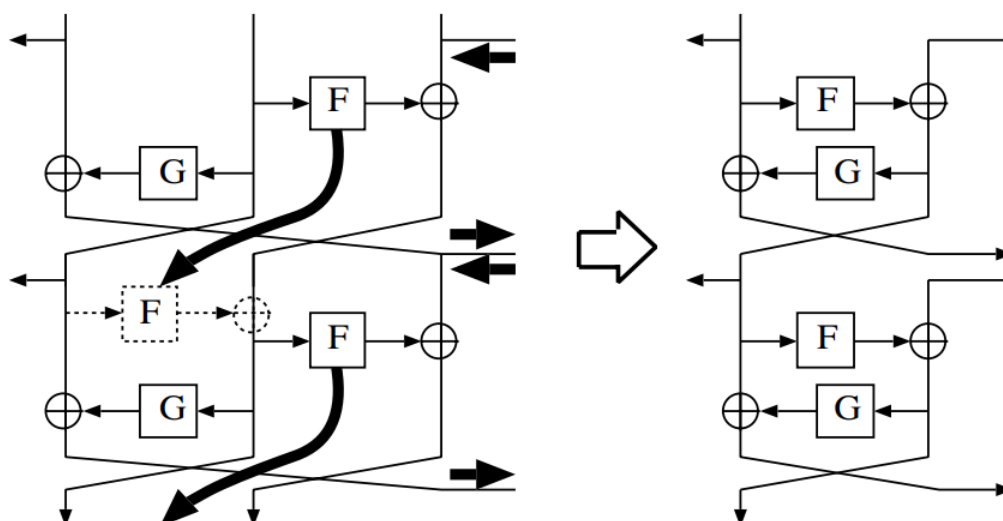
Figure 4. The modified version of the function p

Figure 4 shows some import ant paths of p. Only the five paths shown there ensure that the number of active S-boxes is greater than five. The grid number of the matrix M is defined by $min_{x \neq 0}(w_H(x) + w_H(M_x))$, here $w_H(x)$ is the Hamming weight per byte of x[1]. The grid number of the linear transformation is an important property for the diffusion properties of the block cipher.

But the number of grids of matrix M for PTSG does not guarantee a lower bound on the number of active S-boxes for linear approximation, even if it contains several active F-functions. This property is very different from that of block ciphers.

a)   b)

c)

d)   e)
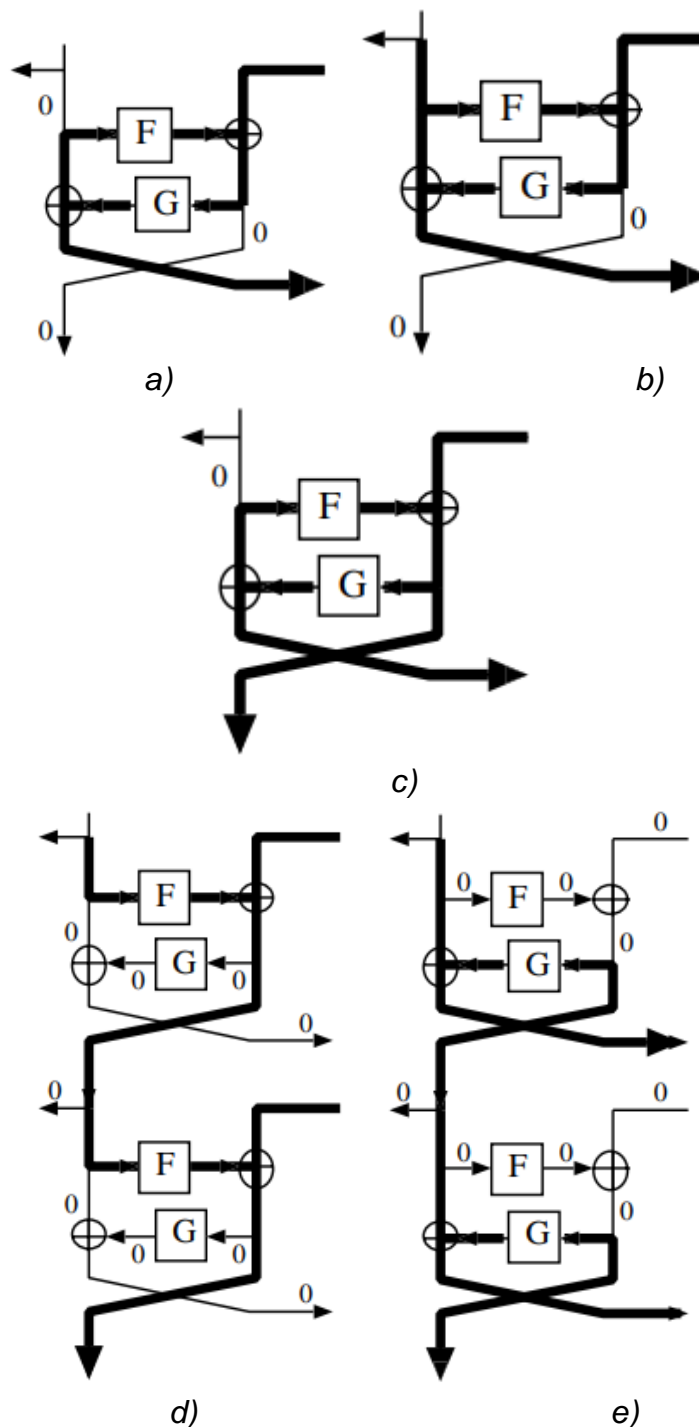
Figure 4. The linear approximations of a function

The *NSA* is linear path of the algorithm. Next, a path is searched that contains a buffer that gives a linear approximation of only the output bits. For PTSGs, the parser can track any number of rounds. Thus, a linear approximation can be constructed with the output of any round. In addition, some linear approximations may miss intermediate p function, which means that more rounds can be observed and the deviation increased. This feature makes sit difficult to search all paths.

The first and last rounds of the path can be marked t_b and t_o. The mask which is done XOR to the data from state a to buffer b is defined as $\Gamma(D)(t)$. In addition, an active F −function can be defined as 1, and F −function close to zero as 0. For example, if F −function is active, but the G −function is not active in the t −period, this is defined as a $\Gamma(a)^{(t)} = (1, 0)$ state.

First of all, we need to pay special attention to the first and last stage of the road. The value of the input mask for all units of the buffer and their state is equal to zero in the first round, and only the mask of the output unit $Chiqish[t_b]$ is active. Only two paths, $a)$ and $c)$ cases in Figure 4, satisfy this condition. The last round is the same as the state $a)$, so the possible paths in the round t_o are shown only as $a)$ and $b)$ states.

In the next step, the effect of the buffer on p is analyzed. The value of $\Gamma(D)^{(t)}$ is equal to 0 in round t_b to round $t_b + 4$ because all input masks are equal to 0 for the first round. Also, the access mask from the buffer to G function must be active, so $\Gamma(D)^{(t_b+5)}$ is active. Similarly, the value of $\Gamma(D)^{(t)}$ is equal to 0 in rounds $t_o - 5 \leq t \leq t_o$ and is active in round $t_o - 5$

If $(\Gamma(a)^{(t_b+i)}, \Gamma(a)^{(t_b+i+1)}) = ((0,0), (1,1))$ is the rounds i ($1 \leq i \leq 4$), it contains more active F −functions in the $a)$ or $c)$ category, that's why it is AS ≥ 25. Therefore, it is only necessary to consider the case $\Gamma(a)^{(t_b+i)} = 0$ for all values of i from 1 to 4. Similarly, the mask of i in the last round must be $\Gamma(a)^{(t_o-i)} = 0$ for all values from 1 to 6. According to this condition is $\Gamma(a)^{(t_b+5)} \neq 0$. Also, $\Gamma(a)^{(t_b+5)}$ and $\Gamma(a)^{(t_o-6)}$ is active and the value of $\Gamma(a)^{(t_o-6)}$ is equal to 0. So, the number of rounds of $t_o - t_b$ should be greater than 14. These results and the activity of $\Gamma(a)^{(t_o-6)}$ indicate $\Gamma(a)^{(t_o-6)} \neq (0,0)$ or $\Gamma(a)^{(t_o-7)} \neq (0,0)$. Therefore, it is AS ≥ 22 in this case.

Results. Resynchronization and related key attack. The resynchronization attack [2,6] is the most effective attack against PTSGs, so it is appropriate to evaluate the NSA algorithm with this method as well. The resynchronization attack can be used not only against the secret key, but also against basic stream cipher generators with a shared parameter. This is an effective attack if the algorithm is very simple to run. Under the assumption that the secret key is unchanged (fixed), the parser first looks for correlations between common parameters and related results. If the correlation probability is high, it can be used to guess the secret key information. For example, linear cryptanalysis in the counter mode of block ciphersis a type of resynchronization attack. The security assessment against the related key attack is similar to resynchronization by replacing the initial vectors with secret keys.

Differential and linear characteristics and integral cryptanalyst [3] options were chosen to evaluate the relationship between NSA inputs and outputs. Attacks against block ciphers using these properties are known as differential cryptanalysis [4] and linear cryptanalysis

[5]. The design of the NSA algorithm generator, especially its functionality, is very similar to the design of block ciphers. This shows that the above two statistical properties are very suitable for estimating the relationship between the initialization vector I and the corresponding internal state.

The maximum differential and linear characteristics of the repetition of p Only the iteration of p is considered and its differential and linear properties are evaluated, ignoring the XOR to the buffer and output arrays. These evaluation methods can be applied similarly to block ciphers.

Table 2 shows the minimum number of active functions in all parts of state arrays for each attack.

Table 2.

The number of active F −functions for linear and differential paths of p

The number of round	…	11	12	13	14	15	16	17	18	19	20	21	22	23
Differensial	…	10	12	12	12	14	16	16	16	18	20	20	20	22
Linear	…	10	12	12	13	14	16	16	17	18	20	20	21	22

Resynchronization attack tolerance: Table 2 shows the relationship between the initialization vector I and the $a(t)$ state arrays in $t −$ iterations. This means that with probability 2^{-128} greater than 23 iterations of p, the differential and non-linear properties.

When running the NSA algorithm, after the initialization vector I is set, only the p function is executed 16 times. Then, the p function is executed 16 times in the compound of the function T. However, the buffer affects the differential and linear characteristics of the ba state only after the 9th iteration, namely, 22 iterations after I is set. Therefore, due to the above characteristics, it can be concluded that it is difficult to observe the deviation after t > 0 iterations.

On the other hand, Table 2 shows that there is some relationship between the initialization vector I and some units of the corresponding buffer b in round 0. However, the differential characteristic is that the output is sequenced, and the buffer contains more than two buffer units. The correlation between these units is too small to observe and achieve the desired result. Therefore, it is impossible for the parser to use this correlation. These properties are also relevant for linear cryptanalysis.

Related Key Attack: Correlation between keys and corresponding outputs is more difficult to observe than correlation between initialization vector and corresponding outputs due to the first shuffling step. Thus, any security shortage was not found using differential and linear cryptanalysis.

Integral cryptanalysis. Due to the high byte-oriented structure, some variants of the Integral cryptanalysis attack [3] can be supported against the NSA algorithm. Integral cryptanalysisis currently the most successful attack against block ciphers with an SPN structure (such as Rijndael, AES, Kuznechik).

Integral cryptanalyst is considered against a block cipher is a chosen plain text attack in which the parser selects several related blocks of plain text, each of which usually differs by only one or two bytes. If a byte contains all values, this selected plain text is called the active set. A set is called a fully selected set if it contains all variants of a byte or two bytes that differ. Because of the complete selectivity in the input of a nonlinear function, the parser can expect to handle the intermediate values to some extent. The parser partially determines the intermediate value controlled by the cipher

text due to the fully selected plain text blocks. If the parser can partially determine the encryption key, he (or she) can distinguish between valid and invalid keys from among the possible key variants.

In stream encryption algorithms, the parser must try to choose a different value of the key orinitialization vector values to perform this attack. Therefore, an Integral cryptanalysis attack should be compared to a bound key attack or a chosen initialization vector attack.

Bind Key Attack: Initially, the attack model needs to be defined. It is assumed that the parser does not know the key value. In order to obtain full selectivity, the parser needs to initialize a set of keys, with the selected keys differing only by a portion of the key value. According to these opinions, the attention is paid to parts which are belong to keys, here the keys differ by one or two bytes. The attacker can't observe anything until a sequence of pseudo-random numbers is generated. It is necessary to check whether the parser can find any feature in the our put sequence between a number of iterations.

Fully selected key set. The set fully selected feature is introduced when initializing the buffer. We specify the

property of the intermediate word in such a way that in each round the corresponding byte part of the set has a different value. For initialization, the passive elements of the set is marked with O which the value is constant. We also introduce the weakest "balanced" property which we mark with Φ, that is, the sum of all values of the corresponding element of the entire set of XOR is equal to zero. If the element of the set is neither active, nor passive, nor balanced, namely, uncontrollable, it is marked with the $*$. If the word triple (A, B, C) has the properties Λ, O and Φ for words A, B, C, then it is defined as,

$$(A, B, C) \xrightarrow{p} \Lambda, O, \Phi \quad \text{or} \quad \text{as} \quad A \xrightarrow{p} \Lambda, B \xrightarrow{p} O, C \xrightarrow{p} \Phi.$$

Obviously, the most effective element for introducing saturation is the last word to affect other elements. Therefore, it is necessary to analyze the situation. $a_0, a_1, a_2 \xrightarrow{p} (\Lambda, O, O)$ the outcome of the $t-$round is determined with (a_0^t, a_1^t, a_2^t). The results of the changes in the characteristics of the set are given in Table 3.

Table 3.

Changes in the properties of a set of elements at intermediate values

Intermediate values	Properties of elements
(a_0^0, a_1^0, a_2^0)	(Λ, O, O)
(a_0^1, a_1^1, a_2^1)	(O, O, Λ)
(a_0^2, a_1^2, a_2^2)	(O, Λ, O)
(a_0^3, a_1^3, a_2^3)	$(\Lambda, \Lambda, \Lambda)$
(a_0^4, a_1^4, a_2^4)	(Λ, Φ, Φ)
(a_0^5, a_1^5, a_2^5)	$(\Phi, *, *)$
$(a_0^{6+}, a_1^{6+}, a_2^{6+})$	$(*, *, *)$

So, the initial values of the buffer b_i will have the following properties depending on the index i:

$$b_i \xrightarrow{p} \begin{cases} O : i = 15,14 \\ \Lambda : i = 13,12 \\ \Phi : i = 11 \\ * : i = 10,9,8, \dots, 0 \end{cases} \quad (1)$$

It should be noted that the properties in (1) do not mean that the parser can

control intermediate values upto b_{11}. In fact, b_{11} can be represented by other buffer

values and the evaluation of F −function (non-linear buffer relations mentioned above). However, due to the randomness in the iterations after the initialization vector is introduced, this feature is eliminated before the output sequence is produced. Therefore, it can be considered that an appropriate key attack based on the Integral cryptanalysis method does not pose any threat to the NSA algorithm.

Resynchronization Attack: This attack may be more practical than cryptanalysis based on key selection above. However, the Initialization Vector does not insert any values into the buffer until 16 iterations of shuffling are complete. Given the number of controlled rounds specified above, 16 iterations are sufficient to eliminate the complete selectivity feature in the selected sets of the shuffling initialization vector.

Conclusion. A new NSA key stream encryption algorithm was proposed in this work. NSA is effective for both hardware and software implementations. Evaluation results of cryptanalytic methods show that NSA is resistant to appropriate key-based attacks and resynchronization attacks. But it is appropriate to evaluate the security of NSA using other analysis methods. Further studies aim to evaluate the security of this algorithm compared to other cryptanalysis methods.

References:

1. J. Daemen, "Cipher and hash function design strategies based on linear and differential cryptanalysis," Doctoral Dissertation, March 1995, K. U. Leuven

2. J. Daemen, R. Govaerts, J. Vandewalle, "Resynchronization weaknesses in synchronous stream ciphers," Advances in Cryptology, Proceedings Eurocrypt'93, Springer-Verlag, LNCS 765, pp. 159-169, 1994.

3. J. Daemen, L. Knudsen, V. Rijmen, "The BlockCipher Square," Fast Software Encryption, Springer-Verlag, LNCS 1267, pp. 149–165, 1997.

4. E. Biham, A. Shamir, "Differential Cryptanalysis of the Data Encryption Standard," Springer-Verlag, 1993

5. M. Matsui, "Linear cryptanalysis method for DES cipher," Advances in Cryptology, Eurocrypt'93, Springer-Verlag, LNCS 765, pp. 159–169, 1994.

6. J. Daemen, R. Govaerts, J. Vandewalle, "Resynchronization weaknesses in synchronous stream ciphers," Advances in Cryptology, Proceedings Eurocrypt'93, Springer-Verlag, LNCS 765, pp. 159-169, 1994.

7. S. Fluhrer, M. Shamir, "Weaknesses in the Key Scheduling Algorithm of RC4," Selected in Areas in Cryptography, SAC 2001, Springer-Verlag, LNCS 2259, pp. 1– 24, 2001.

8. A. Clark, J. Golic, W. Millan, L. Penna, L. Simpson, "The LILI-128 Keystream Generator," NESSIE project submission, 2000, available at http://www.cryptonessie.org

9. S. Fluhrer, "Cryptanalysis of the SEAL 3.0 Pseudorandom Function Family," Fast Software Encryption, FSE 2001, Proceedings, pp. 142–151, 2001.

10. T. Jacobsen and L. R. Knudsen, "The Interpolation AttackonBlockCiphers," Fast Software Encryption, FSE'97, Springer-Verlag, LNCS 1267, pp. 28–40, 1997.

11. P. Rogaway, D. Coppersmith, "A Software-Optimized Encryption Algorithm," Journal fo Cryptography, Vol. 11, No. 4, pp. 273–287, 1998.

12. P. Rogaway, D. Coppersmith, "A Software-Optimized Encryption Algorithm," Fast Software Encryption, FSE'94, Springer-Verlag, LNCS 809, pp. 56–63, 1994

13. Suwais K., Samsudin A. New Classification of Existing Stream Ciphers. Universiti Sains Malaysia(USM), Malaysia 2010.

14. M. Hassan Shirali-Shahreza, Mohammad Shirali-Shahreza. (2006) A new approach to persian/arabic text steganography. In: 5th IEEE/ACIS international conference on computer and information science and 1st IEEE/ACIS international

workshop on component-based software engineering, software architecture and reuse, pp 310-315.

15. Bala Krishnan, Prasanth Kumar Thandra, M. Sai Baba (2017). An overview of text steganography. 4th International Conference on Signal Processing, Communications and Networking (ICSCN -2017), March 16 - 18, 2017, Chennai, INDIA.

16. N.R.Zaynalov, U.Kh.Narzullaev, A.N. Muhamadiev, O.N.Mavlonov, J.Kiyamov, D.Qilichev. Hiding Short Message Text in the Uzbek Language. 2020 International Conference on Information Science and Communications Technologies (ICISCT). https://ieeexplore.ieee.org/document/9351521.

17. Por LY, Delina B (2008) Information hiding—a new approach in text steganography. In:7th WSEAS international conference on applied computer and applied computational science. Hangzhou China,689

18. N.R. Zaynalov, O.N. Mavlonov, A.N. Muhamadiev, D. Kilichev, I.R. Rakhmatullayev. UNICODE For Hiding Information In A Text Document. 2020 IEEE 14th International Conference on Application of Information and Communication Technologies (AICT) | 978-1-7281-7386-3/20 IEEE | DOI: 10.1109/AICT50176.2020.9368819

19. Akbarov D.Ye. Cryptographic methods of information security and their application. - Tashkent, "Mark of Uzbekistan" publishing house, 2009. - 432 p

20. Kharin Yu.S., Bernik V.I., Matveev G.V., Agievich S.V. Mathematical and computer bases of cryptology: Textbook. - Minsk, LLC "New Knowledge", 2003. - 382 p.

COORDINATION OF THE MOVEMENT OF TRANSPORT TYPES IN AREAS WITH HIGH PASSENGER FLOW

MOMINOV TOLKIN

Assistant of Tashkent State Transport University
E-mail: tulqinmuminov643@gmail.com, phone.: (+99890) 168-68-35

YULDOSHEV DAVRON

Doctoral student of Tashkent State Transport University
E-mail: davron.yoldoshev@bk.ru, phone.: (+99897) 411-41-69

Abstract:
Objective. In providing reliable transport service to passengers, it is important to coordinate the movement of transport types taking into account the flow of passengers. In the article, the literature on this issue is analyzed and tasks for mutual coordination of the movement of transport types are determined based on experience.

Methods. Traffic schedules were analyzed to coordinate the traffic of surface public transport and metropolitan routes, types of transport. The main issue is to determine the results of the distribution of the total time of the passenger during the journey and the components of this time.

Results. A general mathematical expression of the arrival time of the passenger at the destination is derived. Research was conducted using the expression and the results were analyzed. The indicators of the passenger's movement as a pedestrian in reaching his destination and his movements in the transport as a passenger were made on the basis of the "Geo Tracker" program. The results of the distribution of the total travel time to the passenger's destination and the components of this time were obtained.

Keywords: Railway, bus, metro, transport infrastructure, transport links, simulation model, transport system, station, bus station.

Introduction. Today, many measures are being implemented to improve public transport infrastructure development. In particular, based on the decision of the President of the Republic of Uzbekistan №. PQ-111 dated February 2,

2022, comprehensive development of the public transport system of Tashkent city, providing quality and safe transport services to passengers, improvement of transport infrastructure, updating the traffic structure with modern buses with all amenities, in order to ensure road safety and create a comfortable environment for pedestrians, important tasks such as the organization of traffic links and coordination of traffic types have been defined at the intersections of surface public transport and metropolitan routes and in places with high traffic flow.[1]

The main purpose of the organization of transport-crossing connections at the intersections of railway, automobile and metro lines and in places with high traffic flow is to make it easier for passengers to transfer from one transport to another, and to ensure that they reach their destinations on time. Every day, thousands of passengers from different regions on national and international routes visit Tashkent city and spread from the station to different parts of the city, as soon as the visiting passengers (guests) leave the station area, they continue their movement using the metro, directional buses, private cars, directional and non-directional vehicles.

The relevance of the scientific research is to ensure that the passengers (guests) visiting the city by railway transport can reach their destination using the city's public transport and to increase the attractiveness of public transport. To achieve the goal, it is necessary to perform the following tasks: [2,3]

- analysis of the traffic schedule of transport types in areas where transport types are connected;

- researching the distribution of passenger flow by types of transport in the areas where the types of transport are contiguous;

- development of a mathematical model of the movement of passengers from railway transport to city public transport;

- coordinating the movement of transport types in areas where transport types are connected.

Literature analysis. Since the coordination of rail and bus traffic is related to many indicators, different researchers have approached the issue in different ways. For example, European researchers A. B. Zulfadly., B. Syahriah., M. O. Marianalar conducted scientific research on reducing traffic and creating comfort for passengers in the area of the railway station. In the study, using the simulation method and the methods of manual counting of passengers, they developed a model for determining and evaluating the factors affecting the actions of passengers. [4]

B. Josef, D. Pavel., K. Jaroslav., M. Jaroslav studied areas where trains and city buses connect. The work focuses on the problems that arise during the use of buses and trains by passengers from railway stations and bus stations. In the simulation model developed as a result of this research, it is possible to show public transport movement times, schedules and the organization of their movement in accordance with each other (trains and buses). [5]

F. Johansson., A. Peterson., A. Tapani focuses on the processes that occur in the areas where the movement of buses and trains is connected. the study presents a simulation model for evaluating the conceptual bus terminal operations in order to prevent traffic jams in the railway station. is based on discrete event simulation and allows to describe the movement and interactions between vehicles in terminals. [6]

A.A.Erofyev and A.Y.Ribichenok created a mathematical model of passenger flow at transport nodes. [7]

Latin American researchers C.E. Cortes., V. Burgos and R. Fernandez, the factors affecting the traffic flow of buses on routes and stopping times at intermediate stops, traffic of other types of vehicles on the road were analyzed using a

microsimulation model. A simulation model of the equipment of bus stops, the formation of passenger demand for buses, the time of buses stopping at the stops, the delay times of buses on the route, the boarding and disembarking times of passengers was developed. [8]

Asian researchers A. Khattak., A. Hussainc conducted a multimodal analysis of passenger traffic based on the TCRP program. In the study, the problem of passenger flow density was optimized by studying the congested and non-congested conditions, the passenger flow increases due to the slow movement of passengers in the transition areas from one transport to another transport, when getting on or off escalators, traffic jams were observed. Research shows that the rate of change in passenger flow is found to be a major factor in passenger congestion.[9]

Kozlov P.I. developed a criterion for comprehensive assessment of passenger traffic at transport hubs and station areas. [10]

V.M. Antonova, N.A. Grechishkina, N.A. The Kuznetsovs developed a simulation model for assessing the level of passenger flow loading in the area of metro stations using the AnyLogic program. [11]

In his research, A.I. Fadeev considered the issue of determining the optimal composition of rolling stock (small, medium and large-capacity buses) suitable for the flow of passengers in city public transport.

A.P. Timalsena and others analyzed the time of excess loss of passengers in traffic jams by mode of transport (bicycle, passenger car, buses of different capacities). In order to reduce the time passengers spend on commuting, they concluded that it is necessary to give priority to the traffic of vehicles during the morning and evening rush hours.

Among them, scientists of our country B.A. Khojayev, G.A. Samatov, S.A. Salimov, Sh.A. Botaev, K.B. Nasretdinov, L.A. Akhmetova, V.S. Bolonenkova, J.R. Qulmuhamedov, K.M. Nazarov, A.A. Nazarov, B.I. Abdullayev and others in the field of improving the technology of passenger transportation on city bus routes , conducted scientific research on creating the scientific basis for improving the quality of transport services.

The research conducted by these scientists shows that in all these works special attention is paid to the quality of transport services provided to the population and its provision. However, the sudden change of indicators affecting the quality of transport services provided to the population has not been studied enough. In addition, in the conducted studies, the issues of on-time arrival of passengers on city bus routes, travel times of passengers in areas where the modes of transport are connected, provision of vehicles in accordance with the flow of passengers, and coordination of the movement of modes of transport have not been sufficiently considered.

Methods. In order to solve the above-mentioned problems, it is necessary to perform the following tasks.

- determining whether the traffic of the city's public transport is compatible with the traffic schedule of the railway transport;

- to study the time of passengers getting off the train, the movement of passengers from the station area to the bus stops (on platforms, corridors);

- determining which type of transport passengers use by conducting questionnaires;

- to study the travel times of passengers based on their gender, age and capabilities by conducting test studies;

- it is necessary to study the level of coverage of the passenger flow by city public transport in the areas where the types of transport are connected and to consider the issues of providing vehicles in accordance with the passenger flow;

- to study the possibilities of a bus station providing service in areas where transport modes are connected;

- selection and justification of the type and number of buses suitable for the flow of passengers;

- to study the level of congestion of the street road network in the areas where the modes of transport are connected and their causes;

- analysis of passenger flow by days, months, years.

Analyzing the traffic schedule of railways, subways, and buses by carrying out the specified tasks, their movement is coordinated and the efficiency of the vehicles is increased. Determining whether passengers reach their destination by conducting surveys helps to determine which type of transport passengers are actively using and the trajectory of their movement, by analyzing the changes in the flow of passengers, it is provided with the required capacity, type, direction, determining the possibilities of bus depots serving in areas where transport modes are connected makes it possible to determine the level of provision of vehicles and transport costs in the present and in the future and by studying the level of loading of the street network in the regions where the types of transport are connected, it is possible to determine the directional vehicles, passenger traffic and the factors affecting them, in general, the tasks and measures specified in this scientific work are shown to the passengers serves to improve the quality of transport services.

Results. Based on the above, we derive a general expression of the passenger's arrival time. If the time spent by the passenger to reach the station is assumed to be conditionally equal to the time spent to reach the destination from the station, the expression will have the following form:

$$T_{\text{um}} = t_p^1 + t_{aq} + t_p^2 + t_{ttk} + t_{ttq} + t_{vp} + t_{ak} + t_{aq} + t_p^3 + \sum t_{\text{qay o'ti}}$$

t_p^1- walking time from home to station

t_{aq}- travel time by car

t_p^2- movement time in the station area

t_{ttk}- waiting time for railway transport

t_{ttq}- travel time in railway transport

t_{vp}- travel time from the railway station to the bus stop

t_{ak}- time to wait for the bus

t_{aq}- bus travel time

t_p^3- walking time from the bus stop to the destination

$\sum t_{\text{qay o'ti}}$- the times spent on re-boarding from one transport to another.

Research was conducted using the above expression and the results were analyzed.

Research results. The test study was conducted to determine the time spent by the passenger in arriving from "Bekabad" district to Odilhojayev street 1, Mirabad district. The indicators of the passenger's movement as a pedestrian in reaching the destination and as a passenger in the transport were performed on the basis of the modern "Geo Tracker" software. In this case, the passenger traveled on the Bekobad-Tashkent (South Station) electric train and bus routes No. 62-46. The distribution of the time spent by the passenger to reach the destination (total 4 hours 15 minutes) is presented in Figure 1.
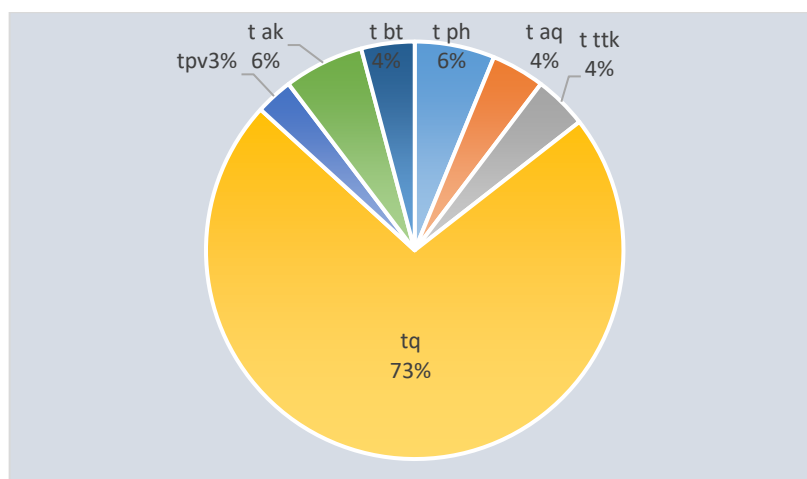
Figure 1. Arriving at the passenger's destination identified in the test surveythe distribution of the time spent on commuting

From the results of the conducted research, it can be seen that a lot of time is spent for the passenger to get back on the transport. The time it takes for the passenger to get back on the transport depends on the distance of walking from the station area to the stop and the waiting time for the transport.

Conclusion. According to the results of the conducted research, the following conclusion was reached:

It is desirable to study the issues of coordinating the movement of transport types in parts where there is a lot of passenger flow. The results of the pilot study showed that the time spent on foot by the passenger from the station area to the bus stop and the time spent waiting for the bus at the stop made up 12% of the total time. This is a lot. Transportation types are implemented by conducting pilot studies of traffic schedules, travel times of passengers and factors influencing them, and travel times of passengers based on their gender, age, and capabilities. Coordination of railway and bus traffic is related to many indicators, and it is necessary to carry out studies to clarify the problems and improve them. The solution of the identified issues is planned in the next scientific researches.

References

1. Decree of the President of the Republic of Uzbekistan dated 02.02.2022 No. PQ-111 "On additional measures to further develop the Tashkent city public transport system".

2. Abdullayev B.I., Mominov T. Sh., Akhmedov D.T., "Time to reach the passenger's destination and indicators affecting it", "Science and innovative development" scientific journal 2021 №1 p. 75.

3. Abdullayev B.I, Yoldoshev D.F, Mominov T.Sh, Akhmedov D.T, Improving the method of assessing road safety at intersections of single-level highways E3S Web of Conferences 264, 05027 (2021). CONMECHYDRO–2021.

4. Zulfadly Azizi Bohari, Syahriah Bachok, Mariana Mohamed Osman Improving the Quality of Public Transportation System: Application of simulation model for passenger movement. Procedia - Social and Behavioral Sciences 153 (2014) 542 – 552

5. Josef BULÍČEK, Pavel DRDLA, Jaroslav Kleprlík, Jaroslav Matuška simulation assessment of reliability by interchange between railway and public bus transport with regard to location of a bus terminal in the municipality June 15 - 17, 2022, Bojnice, Slovakia, EU.

6. Fredrik Johansson, Anders Peterson and Andreas Tapani Discrete Event Simulation of Bus Terminals: A Modular Approach with a High Spatial Resolution Hindawi Journal of Advanced Transportation Volume 2021, Article ID 8862893, 17 pages https://doi.org/10.1155/2021 /8862893.

7. A.A. Erofeev, A. Yu. Ribichenok, Modeling of passenger flows in transport hubs ISSN 2227-1120. Vestnik Belarusian State University of Transport: Science and Transport. 2019. № 2.

8. Cristian E. Cortes, Vanessa Burgos and Rodrigo Fernandez Modeling passengers, buses and stops in traffic microsimulation: review and extensions Journal of advanced transportation J. Adv. Transp. 2010; 44:72–88 Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/atr.110.

9. Afaq Khattak, Arshad Hussain Hybrid DES-PSO framework for the design of commuter circulation space at multimodal transport interchange Mathematics and Computers in Simulation 180 (2021) 205–229.

10. Kozlov Pavel Igorevich Method for the formation of complex criteria for assessing the conditions of movement of passengers in the space of closed communication elements of intermodal transport hubs. Bulletin of Eurasian Science The Eurasian Scientific Journal 2018, № 3, Vol 10 ISSN 2588-0101.

11. V.M. Antonova, N.A. Grechishkina, N.A. Kuznetsov Analysis of the results of the modeling of passenger train stations metro v program AnyLogic Informatsionnye protsessy, Volume 18, No. 1, 2018, str. 35–39.

12. Krystian Birr*, Kazimierz Jamroz, Wojciech Kustra, (2014), Travel Time of Public Transport Vehicles Estimation, 17th Meeting of the EURO Working Group on Transportation, EWGT2014, 2-4 July 2014, Sevilla, (Spain).

13. Stephen Arhin*, Errol Noel, Melissa F. Anderson, Lakeasha Williams, Asteway Ribisso, Regis Stinson, (2015), Optimization of transit total bus stop time models, Department of Civil and Environmental Engineering, Howard University, Washington DC 20059, (USA).

14. Makrand wagale, Ajit Pratap Singha, Ashoke K Sarkar ва Srinivas Arkatkar, Real-Time Optimal Bus Scheduling for a City using A DTR Model- 2nd Conference of Transportation Research Group of India (2nd CTRG)

15. Горохова Е.С, Formation of the schedule of passenger transport with Ant colony-Electronic archive of Tomsk Poliytehnic University.

16. B. Anil Kumar1 · G. Hari Prasath1 · Lelitha Vanajakshi1, Dynamic Bus Scheduling Based on Real-Time Demand and Travel Time- International Journal of Civil Engineering (2019) 17:1481–1489

17. Yaser Elsayed Havas, (2013), Simulation-Based Regression Models to Estimate Bus Routes and Network Travel Times, Journal of Public Transportation · December 2013 (United Arab Emirates).

18. Gudkov V.A., Mirotin L.B., Velmojin A.V., Shiryaev S.A. Passajirskie avtomobilnye perevozki: Uchebnik. Pod ed. V.A. Gudkova. - M.: Goryachaya line - Telekom, 2006. - 448 p.

19. Spirin I.V. Organization and management of passenger road transport, M., Akademia, 2010. – 400 p.

20. Yuldoshev, Davron Furkat Ugli, & Muminov, Tulkin Shoykulovich (2021). City public transport and passenger traffic studying the effect of weather indicators. Oriental renaissance: Innovative, educational, natural and social sciences, 1 (7), 133-142.

21. Yuldoshev Davron, Abdullaev Botir, Yusufkhonov Zokirkhon, & Muminov Tulkin (2022). Determining the impact of weather indicators on passenger traffic in public transport. Universum: технические науки, (1-3 (94)), 64-70.

UDC 677.21:021

ANALYSIS OF RESEARCH RESULTS ACCORDING TO INTERNATIONAL STANDARDS

ABDULLAYEV RAVSHAN

Assistant of the Namangan Institute of Engineering and Technology
Phone.: (+99895) 020-62-10

AZAMBAYEV MUKHAMMADJON

PhD of Namangan Institute of Engineering and Technology
e-mail: mazambayev@gmail.com, phone.: (+99(94) 279-77-89

BAXRITDINOV SAYFUDDIN

Associate professor of Namangan Institute of Engineering and Technology
Phone.: (+99893) 942-61-82

Abstract: This article provides analyses after conducting scientific and practical research on international and universal standards of cotton fiber. And also, methods, definitions and designations of studies are considered, both the class method and the HVI laboratory system. The classification of medium-fiber cotton fiber according to American universal standards is considered.

Keywords: cotton fibre, international standart, result, investigation, analysis, dusty gin, sort, HVI laboratory system, index, quality.

After conducting scientific and practical research on international and universal standards of cotton fiber, the following terms, definitions and designations are used:

Class method – organoleptic evaluation of cotton fiber by grade and class by comparison with the samples of appearance approved in the prescribed manner and determination of the staple length by laying out the staple manually. Instrumentally determine only the index of micronaires. The method is used to control 10% of bales from a batch, but can also be used for bale tests.

HVI (High Volume Instruments) – short designation of the name of the measuring system for testing high-performance cotton fibers in terms of length, uniformity in length, strength, elongation at break, micronaire, color and clogging.

Appearance samples – samples, which are a set of qualitative characteristics of cotton fiber in terms of color, presence of spots, structure and contamination, typical for a particular variety and class of cotton fiber, approved in the prescribed manner.

Samples are made separately for long-staple and medium-staple cotton fibers.

Special application methods – traditional instrumental methods for testing cotton fiber on a small sample obtained by repeated averaging and reducing the mass of samples taken from different bales or from different places of the tested sample of cotton fiber. The methods are characterized by high labor intensity and duration of testing, low representativeness of the test sample, and are not used for the purposes of certification of cotton fiber. The methods are used in assessing the quality of raw cotton, in the work of breeders and in the control of technological processes at ginneries and textile enterprises.

Micronaire indicator – Micronare (Mic) – characteristic of fineness and maturity of cotton fiber, determined by the air permeability of a fiber sample (baziz 3.5-4.9).

Upper Half Mean Length (UHM) – the average length of the longest fibers, which are half the length of the fiber under test, expressed in inches or mm.

Staple Length 32-nds (Staple) – the length of the fiber, visually determined by

the classifier from a staple of parallel fibers laid out by him manually, and expressed in 1/32 of an inch (for example, 1 1/32), or in a code equal to the number of intervals of 1/32, in this example - 33.

Mean Length (ML) – the average length of all fibers in the sample.

Uniformity Index (Unf) – a characteristic determined by the ratio of the average fibers to the upper average length, expressed as a percentage.

Short Fiber Index (SFI) – proportion of short fibers in the sample with a length of less than 0.5 inches (12.7 mm), expressed as a percentage.

Reflectance (Rd) – The amount of color reflected by the surface of the tested sample of cotton fiber, expressed as a percentage.

Yellowness (+b) – the degree of yellow component of the color in the test sample.

Trash Code (T) – indicator of contamination with non-fibrous impurities, determined by the area of weed impurities per ten. For example, if the proportion of

the area of trash is 0.4%, then the Trash code is 4.

Trash Area (Area) – the total area of weed particles, determined instrumentally on the HVI system by scanning the surface of the sample, expressed as a percentage of the surface area of the tested part of the sample.

Trash Count (Cnt) – the number of individual weed particles in a sample 0.01 inch (0.25 mm) or larger in diameter.

Strength (Str) – the strength of the cotton fiber, expressed in the HVI graduation of the sizing cotton (HVI Calibration Cotton), gf/tex.

Elongation (Elg) – elongation of the fiber by the time it breaks on the HVI dynamometer, expressed as a percentage.

In 2016-2022, a new gin machine (pneumo-mechanical gin) was developed and manufactured to separate the fiber from the seed. We test the obtained fiber samples from the research on the HVI system according to the international standard and analyze the data obtained:

Table 1

Comparative table on ginning of raw cotton and designation of data according to international standards (breeding fiber variety-Porlock-2, I/1)

№	Names and designations according to international standards - ISO.	Obtained data from an existing saw gin (4DP-130). The test was carried out on the system HVI 900 – SA.	Data obtained from the new pneumo-mechanical genie.
	Len –Staple Length 32-nds inch, mm.	1.14	1.22
1.		34.1	36.6
2.	Unf – Length uniformity index, %	84.5	84.8
3.	SFI - Short fiber index, %	7.7	5.2
4.	Mic – Micronaire.	4.2	4.1
5.	Elg –Elongation, %.	7.3	7.7
6.	Str –Strength,gf/tex.	33.3	34.5
7.	Rd – Reflectance, %.	77.5	79.8
8.	+ b – Yellowness.	8.8	6.8
9.	Trash – Trash Code.	3.7	6.0
10.	Cnt –Trash Count.	11	10
11.	Area – Trash Area, %..	0.8	0.6

We analyze the designations and comparative data of Table 1. The names and designations of quality indicators according to international standards on the HVI

laboratory system are given in a very wide range. This can be clearly seen by comparing the data between saw and pneumo-mechanical gins.

In 2009-2019, NamMITI scientists developed and manufactured an innovative, industrial machine "Cotton and textile waste ginner for spinning and cotton ginning".

Table 2

The obtained samples of fibers from cotton waste are tested in the HVI system according to international standards

№	Names and designations according to international standards - ISO.	Fibers from cotton waste		
		Uluk fibers	Fibers from the standard - 3	Fibers from the standard - 7
		The tests were carried out on the HVI system 900-SA		
1.	Len –Staple Length 32-nds.	1.08	1.09	1.12
		32.4	32.7	33.5
2.	Unf – Uniformity Index, %	83.1	83.4	82.9
3.	SFI - Short Fiber Index, %	9.6	9.8	11.7
4.	Mic – Micronaire.	4.4	4.6	4.5
5.	Elg –Elongation, %.	5.8	6.8	6.4
6.	Str –Strength, gf/tex.	32.4	34.2	30.6
7.	Rd –Reflectance, %.	64.6	62.8	60.6
8.	+ b – Yellowness.	10.0	9.8	9.8
9.	Trash – Trash code.	5	6	4
10.	Cnt – Trash Count.	18	20	22
11.	Area –Trash Area, %.	1.8	1.4	1.3

The requirements for varieties and quality of ginning are determined by standard physical samples placed in special classification boxes. Each box contains one variety by color and weediness with six cells, reflecting the possible variations in appearance and color.

Table 3

Classification of medium staple cotton fiber according to international standards – ISO

Variety	Symbol	Code	Availability of standards
White			
Good Middling	GM	11	+
Strict Middling	SM	21	+
Middling	Mid	31	+
Strict Low Middling	SLM	41	+
Low Middling	LM	51	+
Strict Good Ordinary	SGO	61	+
Good Ordinary	GO	71	+
Below Grades	BG	81	-
Light Spotted	GM Lt Sp	12	-
	SM Lt Sp	22	-
	Mid Lt Sp	32	-
	SLM Lt Sp	42	-
	LM Lt Sp	52	-
	SGO Lt Sp	62	-
	BG Lt Sp	82	-

Good Middling
Strict Middling
Middling
Strict Low Middling
Low Middling
Strict Good Ordinary
Below Grades

Spotted			
Good Middling	GM Sp	13	-
Strict Middling	SM Sp	23	+
Middling	Mid Sp	33	+
Strict Low Middling	SLM Sp	43	+
Low Middling	LM Sp	53	+
Strict Good Ordinary	SGO Sp	63	+
Below Grades	BG Sp	83	-
Tinged			
Strict Middling	SM Tg	24	-
Middling	Mid Tg	34	+
Strict Low Middling	SLM Tg	44	+
Low Middling	LM Tg	54	+
Below Grades	BG Tg	84	-
Yellow Stained			
Strict Middling	SM YS	25	-
Middling	Mid YS	35	-
Below Grades	BG YS	85	-

According to Table 3, the color of the medium staple cotton fiber should be white. Different saturation of yellowness is taken into account when separating cotton fiber into groups by color: White, Light Spotted, Spotted, Tinged и Yellow Stained.

Conclusions.

1. Use of international standards when conducting research requirement period.

2. Applying international standards to research is helping drive up fiber prices on the Liverpool Exchange.

3. The Bremen round of testing requires the international standard of Uzbek cotton in the analysis of results and related work.

4. Fiber classification in price differentiation and quotation requires international standard.

References

1. https://www.lex.uz/ru/docs/5731033, Пахта-тўқимачилик кластерлари фаолиятини тартибга солиш чора-тадбирлари тўғрисида. Ўзбекистон Республикаси Президентининг Фармони, 16.11.2021 йилдаги ПФ-14-сон.

2. Джабаров Г. Д., Балтабаев С. Д., Котов Д. А., Соловьев Н. Д. Первичная обработка хлопка. Москва «Легкая индустрия» 1978 г. 3-63 с.

3. Методическое пособие. «Определение качественных показателей хлопкового волокна на измерительной системе HVI 900-SA. Ташкент – 2001 г. 3-24 с.

4. Волокна хлопковое. Технические условия. Ташкент – 2001 г. 15-27с.

5. B.T. Aliyev, A.A.Maxmudov, A.I. Karimov. Theoretical analysis of the working bodies of the spinoff in cotton waste. International Journal of Advanced Science and Technology Vol. 29, No. 12s, (2020), pp. 1891-1897.

6. B.T. Aliyev, A.A.Maxmudov, A.I. Karimov. Mathematical Modeling of The Interaction Of Cotton Wastes With The Discrete Position of The Mass Of Cotton Waste. International journal of advanced science and technology Vol. 29, No. 9s, (2020), pp. 6313-6320.

7. A.A.Maxmudov, B.T. Aliyev, A. Bobomatov. Detection of influencing forces of cotton flier on the elastic plate of impurity taking grid of the cleaner. International Journal of Engineering Research & Technology. (IJERT) ISSN: 2278-0181 Vol. 9 Issue 02, February-2020.

8. Р.К.Абдуллаев, Р.М.Мурадов, Б.Т.Алиев. Пахта чиқиндилари таркибидаги йигирувга яроқли толаларни ажратиш қурилмаси. Бухоро муҳандислик-технология институти. "Илмий тадқиқот ва кадрлар тайёрлаш тизимида инновацион ҳамкорликни ривожлантиришнинг муаммолари ва истиқболлари" мавзусида халқаро илмий-амалий анжумани материаллари. Бухоро, 24-25 ноябр 2017 йил, 102-105 бет.

9. Б.Т.Алиев, Р.К.Абдуллаев, Р.М.Мурадов. Пахта толасини чигитдан ажратишда янги пневмомеханик жин машинасининг яратилиши ва тадқиқотлар таҳлили. Ўзбекистон табиий толалар илмий тадқиқот институти, халқаро илмий-техникавий анжуман. "Тўқимачилик саноати корхоналарида ишлаб чиқаришни ташкил этишда илм-фан интеграциялашувини ўрни ва долзарб муаммолар ечими" (ЎзТТИТИ-80) материаллар тўплами. Тўқимачилик материаллари технологияси 2-қисм. Марғилон, 27-28 июл 2017 йил 106-111 бет.

10. Х.Т.Ахмадходжаев, А.А.Обидов, Р.К. Абдуллаев, М.И.Охунжонова.

11. Пахта толаси таркибидаги калта толалар фоизини камайтириш борасидаги олиб борилаётган илмий-тадқиқот ишлар ва натижалар тахлили. Наманган муҳандислик-технология институти илмий-техника журнали. "Ишлаб чиқариш технологияси муммолари" Том 4 №1 2019 3-7 бет.

12. Р.К.Абдуллаев, Х.Т.Ахмеджоджаев, М.И.Охунова, М.М.Султонов.

13. Пахтани жинлаш жараёнида жин машинасининг селекция навлар бўйича тола сифатига таъсирини таҳлил қилиш. Наманган муҳандислик-технология институти илмий-техника журнали. "Ишлаб чиқариш технологияси муммолари" Том 4 №2 2019 21-27 бет.

14. Ўзбекистон давлат стандарти. Пахта толаси. Техникавий шартлар.

15. Тошкент-2001й. 2-11 бет.

16. Узбекский центр сертификации хлопкового волокна "Сифат". Методическое пособие. Ташкент-2001г. 3-25 стр.

17. Ғ.Ж.Жабборов, Т.У.Отаметов, А.Х.Ҳамидов. Чигитли пахтани ишлаш технологияси. Тошкент "Ўқитувчи" 1987й. 128-146 бет.

18. Р.К.Абдуллаев, Р.М.Мурадов, М. Н. Салохиддинова. Пахта толаси сифатини оширилишида илм-фан ва ишлаб чиқариш интеграцияси истиқболлари. "Инновацион ривожланиш даврида интенсив ёндашув истиқболлари" халқаро анжумани. Наманган, 2018 йил 10-11 июл, 246-247 бет.

19. Р.К.Абдуллаев, А.А.Обидов, Р.М.Мурадов. Пахтани қайта ишлаш инновацион технологияларини яратилишида саноат ва илм-фан ўртасидаги кооперацияни йўлга қўйиш истиқболлари. "Инновацион ривожланиш даврида

интенсив ёндашув истиқболлари" халқаро анжумани. Наманган, 10-11 июль 394-398 бет.

20. М.М.Султонов, Р.К.Абдуллаев. Тўқимачилик кластери комплекслари технологик жараёнларида тола йўқотилиши кескин камайтириш чора-тадбирлари. Наманган муҳандислик-технология институти илмий-техника журнали. "Ишлаб чиқариш технологияси муммолари" Том 4 №3 2019 66-73 бет.

21. Р.К.Абдуллаев, Х.Т.Ахмедходжаев, О.Ш.Саримсоқов, М.И.Охунжонова. Пахта толаси сифат кўрсаткичларини халқаро универсал стандарт бўйича аниқланишида "сифат" сертификатлаш маркази билан ҳамкорлик интеграциясини мустаҳкамлаш истиқболлари. Наманган муҳандислик-технология институти илмий-техника журнали. НамМТИ, 2018 й. 4-сон 25-31 бет.

22. Abdullayev R. , Muradov R. , Karimov A. B. , Aliyev B. "New bunker feeder for universal feeding of seed cotton in saw and pneumomechanical gins" 76th Plenary Meeting of the International Cotton Advisory Committee (ICAC) "Cotton in the era of globalization and technological progress" XIII International Uzbek cotton and textile fair Digest of scientific and technical achievements in the republic of Uzbekistan. Tashkent – 2017. 234 – 238 pages.

COTTON FIBER RATING, INNOVATION CURRENT DEVELOPMENTS, PROSPECTS FOR COOPERATION OF FARMS AND CLUSTERS

ABDULLAYEV RAVSHAN

Assistant of the Namangan Institute of Engineering and Technology
Phone.: (+99895) 020-62-10

AZAMBAYEV MUKHAMMADJON

PhD of Namangan Institute of Engineering and Technology
e-mail: mazambayev@gmail.com, phone.: (+99(94) 279-77-89

Abstract: The article shows the results of six varieties of cotton seed breeding varieties grown by supplying them with high yields with advanced agrotechnical methods, production of high-quality cotton fiber from cultivated raw cotton, introduction of new technologies, as well as the classification of the resulting cotton fiber based on the international universal ISO standard, as well as conducted scientific and practical research in determining the rating place of the fiber.

Key words: raw cotton, fiber, joint, farmer, fiber rating, quality, genie machine, pneumomechanical women, textiles, micronair, research, laboratory system HVI, selection type.

Class method -Today, cotton seeds of many breeding varieties are planted on the territory of the republic. For example, while varieties S 65-24 and Namangan-77 have been widely planted for more than 35 years, such breeding varieties as Andijan-35, Andijan-36, glossy-1, glossy-2, glossy-3, Namangan-34 are relatively new varieties. In addition, our breeders create a large number of breeding varieties, conduct scientific and practical research and conduct pilot work.

Experts of the spinning enterprises of the Kalava cotton textile cluster, as well as other spinning enterprises, pay more attention to such quality indicators as the length of cotton fibers (Len - high average length), microneedles (microfibre maturation and thinness, thickness), as well as the percentage of short fibers in fibers (SFI-short fiber index). This is a true and necessary condition, with special emphasis on the optimal state of the microneedle, which is 4.0, 4.1, 4.2, 4.3,.

Cotton farms, on the other hand, want to plant cotton varieties that are primarily fertile, resistant to diseases, have a short growing season and are low in water.Grief in this case is considered quite correct and understandable.

First of all, the production of cotton fibers began with the determination of quality indicators in the HVI laboratory system in accordance with the International Universal ISO Standard.

According to 10 quality indicators, based on a 10-point system, the rating position of the fibers of the grade 6-N selection was as follows:

Table 1.

Fiber rating position	Selection variety of fibers.	Total points awarded under the HVI system.
1.	Glossy-2	91
2.	C 65-24	74
3.	Namangan-77	70
4.	Andijan -35	64
5.	Namangan -34	57
6.	C 82-86	56

Selection varieties of cotton fibers recorded according to this table 1; Quality indicators were determined based on the international ISO standard such as Len-high average fiber length, UNF-longitudinal uniformity, SFI-short fiber index, Mic-microneedle, Elg-elongation at discontinuity, Str-specific elongation strength, Rd-beam return coefficient, Tb-fiber yellowing rate, Trask-impurity code, Cnt-amount of impurities, and Area-dirty mixing area.

From the table, it can be seen that the newly created glossy-2 selection grade was given 1st place in the reting relay due to the increased uniformity of the fiber in terms of high length and length due to the gene nakautized. Despite being a relatively old variety, it is seen that the S 65-24 and Namangan-77 varieties have not lost their former quality indicators. Despite being a relatively new Variety, the varieties Andijan-35, Namangan-34 and S 82-86 ranked fourth, fifth and sixth, respectively.

Scientific and practical research is also being carried out in the direction of setting ranking positions on other selection varieties being planted in the Republic.

It is known that in the separation of fibers and seeds from cotton, that is, in the Jinning of cotton, saw gin machines are used for medium-fiber cotton, and roller gin machines for thin-fiber cotton.

In existing saw gin machines, Jinned cotton fibers were found to be quality indicators in the USA HVI laboratory system according to the 6 different selection varieties shown in Table 1. In order to study the extent to which mechanical damage is caused to the natural quality of fiber and seeds in the process of cotton ginning, according to the 6 different selection varieties of cotton listed in the table above, fibers from the seed were separated by hand without mechanical damage, that is, fibers from the seed. The separated fibers were tested in the HVI laboratory system. The saw was compared with the quality of the fibers from the Gin machine.

The comparison table showed that the cutting of fibers in the Len-high average length on a saw gin machine is on average 3-5 percent in terms of 6 homogeneous selection varieties under consideration. This pointer also has a corresponding negative effect on the percentage of SFI-short fibers in the fiber content.

In the Arrali jin machine, a condition not yet known to science has been discovered, that is, the Str-specific elongation force of fibers in the raw material chamber is decreasing by 2.0-2.4

Gs/Tex. It will be necessary to study the cause.

From 2016, work began on the creation of a fundamentally new "Pneumomechanical gin machine" at NamIET to separate fibers and seeds from cotton. A small experimental copy of the new gin was prepared and scientific and practical work was carried out, the fibers obtained were tested in the HVI system. (Selection variety glossy-2, I/1).

Table 2.

The results of the comparison were as follows:

№	Fiber HVI is the name and designation of quality indicators in the laboratory system.	Quality indicators of fibers that come out of the sawed gin.	Fiber quality from the experimental machine of the new pneumomechanical gin	Fiber natural quality indicators
1	2	3	4	5
1.	Len -Upper Half Mean Length. dyuym.mm	1.14 28.9 mm (34.1 mm)	1.22 31.0 mm (36.6 mm)	1.34 34.0 mm (40.1 mm)
2.	Unf -Uniformity Index, %	84.51	84.80	85.10
3.	SFI- Short Fiber Index. Index of short fibers,%	7.75	5.2	2.7
4.	Mic.- Micronare.	4.6	4.1	4.2
5.	Elg. - Elongation, %	6.89	7.30	7.0
6.	Str -Strength Specific break strength, Gs/teks	33.20	34.30	35.60
7.	Rd- Reflectance. Beam return coefficient	77.03	79.80	82.60
8.	Tb -Yellowness.	8.86	6.80	8.10
9.	Trash -Trash Code.	3.9	4.0	4.0
10.	Cnt -Trash Count.	10	6	4
11.	Area- Trash Area. %	0.6	0.8	0.4

It will be possible to conduct a very in-depth analysis in accordance with Table 2. For example, the state of changes in Len fibers of a higher average length indicates a much more serious condition. Taking into account the fact that the existing saw gin production machine causes serious mechanical damage to the fibers, the creation of another new, innovative gin production machine becomes extremely relevant.

Len-the change in the diagram of the high average length of the fibers:

SFI- Short fiber index (%)
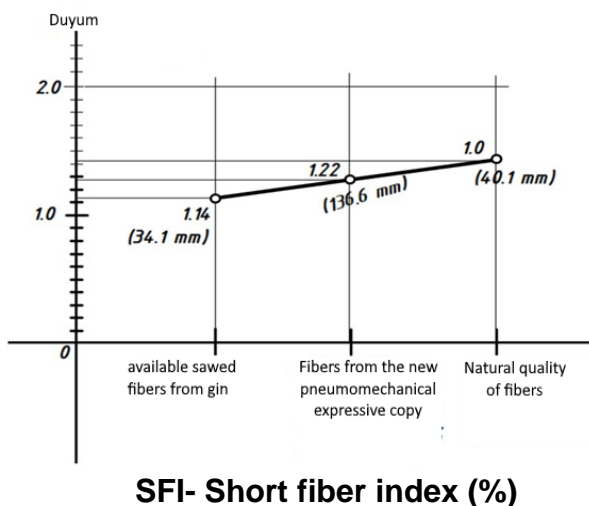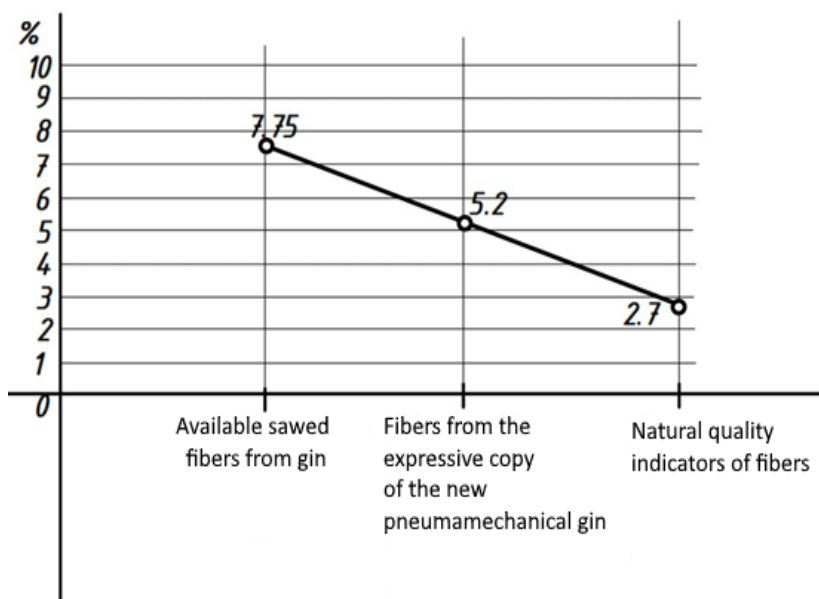
It is known that the percentage of short fibers in fibers is understood to be those that are shorter than 0.5 inches (12.7 mm) in length. Such fibers do not reach in the combing machine, that is, these short fibers do not reach the spinning machine.

The fact that the existing saw machine cuts the fibers in the machine and exceeds the percentage of short fibers remains a problematic situation. The natural quality of the fibers has also been proven in studies in which short fibers account for about 2.4-2.7% in holti. This condition was taken into account in the production of high-quality fibers.

In low-grade fibers, that is, grade IV-V fibers, short fibers account for 14-20%.

In low-grade, i.e., IV-V grade fibers, short fibers are 14-20%.

Innovative projects on achieving high quality and high productivity are also being prepared in cooperation with cotton farms and textile clusters. That is, in order to increase the cotton dressing to 70-75 centners, it will be necessary, first of all, to organize poultry farming on farms, to prepare it for humus by rotting manure, and to land in early spring. It will be necessary that the cotton drip irrigation system is also carried out by farms in cooperation with clusters. It is also ensured that the benefits from poultry and eggs cover much more costs, as well as the creation of new jobs.

Significant work is also being carried out by scientists from the Namangan Institute of Engineering and Technology in order to significantly improve the quality of lint obtained during lintering. The main goal is to separate and improve the quality of down in accordance with the standard requirements of Type A (Grade I, Grade II, higher, medium, dirty grade) and Type B (Grade I, Grade II, higher, medium, dirty grade).

First of all, in this direction, a device is being tested on a 5 hp linter machine to improve the quality of down by cleaning pollen on vibrating mesh surfaces. The next task was to create a vacuum cleaner and a type separation machine.

The first scientific and practical studies on a sharp improvement in the quality of down began to give their positive result. That is, moles from the dirty class are transferred to a higher class. In turn, type II switches to fluffy I-NAV. The price of torque, which is determined on the stock exchange, respectively, also rises sharply. Types A and B remain in place. Due to this, the length of the fluff does not depend on the efficiency of cleaning.

One of the real scientific and technical achievements of recent years at the Institute was the creation of a large industrial copy of the "device for extracting pure spinning fibers from industrial cotton

171

waste", which received high results. That is, in industry, it was possible to obtain an additional 5-5.5% of cotton fiber. Currently, measures are being taken to commercialize innovative devices worldwide and in tabular format.

Conclusion. 1) first of all, it is an urgent issue to determine their natural quality indicators on the selection varieties of cotton in the US HVI laboratory system and determine the position of reting.

2) the creation of the innovative device "creation of a Pneumomechanical gin machine" in relation to the Jinning of cotton in a new way is a huge scientific and technical achievement, which is receiving high results.

3) the project of obtaining 70-75 centners of cotton in cooperation with farms and cotton textile clusters is extremely relevant.

4) the successful start of innovative scientific and practical work in the direction of a sharp increase in the quality of fluff (lint) is also becoming relevant and significant.

5) the creation of an industrial copy of a pure, spinable fiber extraction device from industrial cotton waste is important to the economy, and its rapid commercialization will be extremely important.

References

1. https://www.lex.uz/ru/docs/5731033, on measures to regulate the activities of cotton-textile clusters. Decree of the president of the Republic of Uzbekistan, PF-14 of 16.11.2021.

2. Djabarov G. D., Baltabaev S. D., Kotov D. A., Solovev N. D. Pervichnaya obrabotka khlopka. Moscow "Legkaya industriya" 1978 g. 3-63 PP.

3. Metodicheskoe posobie. "Opredelenie kachestvennix pokazateley xlopkovogo volokna na izmeritelelnoy sisteme HVI 900-SA". Tashkent-2001 g. 3-24 P.

4. Volokna khlopkovoe. Technicheskie uslovia. Tashkent-2001 g. 15-27S.

5. B.T. Aliyev, A.A.Makhmudov, A.I. Karimov. Theoretical analysis of the working bodies of the spinoff in cotton waste. International Journal of Advanced Science and Technology Vol. 29, No. 12s, (2020), pp. 1891-1897.

6. B.T. Aliyev, A.A.Makhmudov, A.I. Karimov. Mathematical Modeling of the Interaction of Cotton Wastes with the Discrete Position of the Mass of Cotton Waste. International journal of advanced science and technology Vol. 29, No. 9s, (2020), pp. 6313-6320.

7. A.A.Makhmudov, B.T. Aliyev, A. Bobomatov. Detection of influence forces of cotton flier on the elastic plate of impurity taking grid of the cleaner. International Journal of Engineering Research & Technology. (IJERT) ISSN: 2278-0181 Vol. 9 Issue 02, February-2020.

8. R.K.Abdullaev, R.M.Muradov, B.T.Aliev. A spinning fiber separation device containing cotton waste. Bukhara Institute of engineering and technology. Materials of the international scientific and practical conference on the topic "problems and prospects for the development of innovative cooperation in the system of scientific research and training." Bukhara, November 24-25, 2017, pp. 102-105.

9. B.T.Aliev, R.K.Abdullaev, R.M.Muradov. Analysis of the creation and research of a new pneumomechanical gin machine in the separation of cotton fiber from seeds. Scientific Research Institute of natural fibers of Uzbekistan, international scientific and technical conference. "The role of science integralization in the organization of production at enterprises of the textile industry and the solution of pressing problems" (Özttiti-80) is a set of materials. Textile materials technology Part 2. Margilon, 27-28 July 2017 pp. 106-111.

10. X.T. Akhmadhodjaev, A.A.Obidov, R.K. Abdullaev, M.I.Okhunjonova. Research work and results on reducing the percentage of short fibers in cotton fiber are estimated. Scientific and technical Journal of Namangan Institute of engineering and technology. "Production technology mummies" Tom 4 No. 1 2019 pp. 3-7.

11. R.K.Abdullaev, H.T.Akhmedzhodzhaev, M.I.Okhunova, M.M.Sultanov. Analysis of the effect of the Gin machine on the quality of fiber by selection varieties in the process of ginning cotton. Scientific and technical Journal of Namangan Institute of engineering and technology. "Production technology mummies" Tom 4 No. 2 2019 pp. 21-27.

12. State standard of Uzbekistan. Cotton fiber. Technical conditions. Tashkent-2001y. Pp. 2-11.

13. Uzbeksky tsentr certasii khlopkovogo volokna "quality". Metodicheskoe posobie. Tashkent-2001g. 3-25 str.

14. G'.J.Jabborov, T.U.Otametov, A.X.Hamidov. Technology for processing seed cotton. Tashkent "teacher" 1987y. Pp. 128-146.

15. R.K. Abdullaev, R.M.Muradov, M. N. Salokhiddinova. Prospects for science and production integration in improving the quality of cotton fiber. International Conference" prospects for an intensive approach in the era of innovation development". Namangan, July 10-11, 2018, pp. 246-247.

16. R.K.Abdullaev, A.A.Obidov, R.M.Muradov. Prospects for establishing cooperation between industry and science in the creation of cotton processing innovation technologies. International Conference "prospects for an intensive approach in the era of innovation development". Namangan, 10-11 July 394-398 PP.

17. M.M. Sultanov, R.K.Abdullaev. Measures to dramatically reduce fiber loss in the technological processes of textile cluster complexes. Scientific and technical Journal of Namangan Institute of engineering and technology. "Production technology mummies" Tom 4 No. 3 2019 pp. 66-73.

18. R.K. Abdullaev, H.T.Akhmedkhadzhaev, O. S. Garilakov, M.I.Okhunjonova. Prospects for strengthening the integration of cooperation with the "quality" certification center in the determination of quality indicators of cotton fiber by the International universal Standard. Scientific and technical Journal of Namangan Institute of engineering and technology. Nammti, 2018. Issue 4 pp. 25-31.

19. Abdullayev R., Muradov R. , Karimov A. B. , Aliyev B. "New bunker feeder for universal feeding of seed cotton in saw and pneumomechanical gins" 76th Plenary Meeting of the International Cotton Advisory Committee (ICAC) "Cotton in the era of globalization and technological progress" XIII International Uzbek cotton and textile fair Digest of scientific and technical achievements in the republic of Uzbekistan. Tashkent – 2017. 234 – 238 pages.

UDC. 677.085.

CALCULATION OF THE LOAD ON THE FRICTION CLUTCH OF THE SEWING MACHINE

DUSTOVA FIRUZA

Doctoral student of Tashkent Institute of Textile and Light Industry
Phone.: (+99897) 745-94-55

BABADZHANOV SABIT

Associate Professor of Tashkent Institute of Textile and Light Industry
Phone.: (+99890) 346-05-09

Annotation. The article considers a disc friction clutch, a sewing machine drive, the condition for its performance, the calculation of axial force, and the wear resistance of a friction pair. In the process of switching on the friction clutch, sliding occurs between the parts with which the clutch halves are engaged. It is noted that the adhesion strength in the clutch depends on the coefficient of friction and its stability when changing the sliding speed, pressure and temperature.

Keywords: friction clutch, clutch, sliding, shaft, friction forces, coupling half, belt drive, wear resistance, heat resistance, adhesion, cohesion, friction moment, friction coefficient.

Of the controlled mechanical clutches, friction clutches are the most common, since they provide smooth engagement and disengagement of the sewing machine drive shafts [1-4]. Such coupling of the shafts is provided by frictional forces between the mating parts of the coupling half, which can be easily adjusted by changing the degree of compression of these parts. In the process of switching on the friction clutch, sliding occurs between the parts with which the clutch halves are engaged. With steady motion, this slip is absent. During overloads, such slipping is possible and, therefore, the friction clutch can serve as a safety device. In addition, the working principle of the friction clutch is the basis of the sewing machine speed control widely used in modern machines.

Electric drives with friction clutches are widely used. Such drives are used in sewing machines for general purposes, in machines for performing tightening operations, etc. [5, 6].
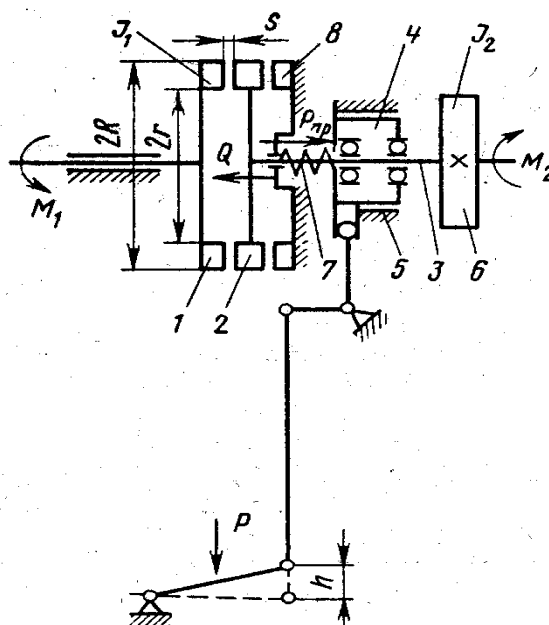

Fig.1. Kinematic diagram of the friction clutch of the sewing machine drive

A schematic diagram of a drive with a friction clutch of sewing machines is shown in fig. 1. The driving part of the drive is the half-coupling 1 with a flywheel, and the driven part is the half-coupling 2, sitting on the shaft 3. The shaft is placed in the bearings of the glass 4, which has the possibility of axial movement of the guide 5. At the right end of the shaft 3, a pulley 6 is fixed, connected by a belt drive with the drive shaft of the sewing machine. A spring 7 is placed between the cup 4 and the frame, which presses the driven part of the clutch to the fixed brake ring 8. In the idle state, the driven half-clutch is pressed against the ring by a spring and cannot rotate, and the driving half rotates at a constant speed equal to the idle speed of the electric motor ω_o. To turn on the clutch, it is necessary to move the cup 4 together with the half-coupling 2 to the left and press it against the leading half-coupling with force Q.

It should be noted that friction clutches do not allow shaft misalignment. The centering of the coupling halves is achieved either by their location on one shaft, or by using special centering rings.

During the inclusion of the friction clutch, slippage of the rubbing surfaces is inevitable, accompanied by the release of heat. Therefore, friction materials used in couplings must be wear-resistant and heat-resistant [7-10]. The strength of the clutch in the clutch depends on the coefficient of friction and its stability when changing the sliding speed, pressure and temperature. The condition of operability, lack of slippage of the friction clutch is written as follows:

$$M_{fr} = T \cdot K, \text{ (Nm)} \qquad (1)$$

where M_{fr} is the moment of friction on the coupling halves; K = 1.25 ... 1.5 - coefficient of adhesion reserve;

M is the torque transmitted by the clutch (the product of M is called the calculated torque).

Friction moment:

$$M = fQ\frac{D}{2} \qquad (2)$$

where f is the coefficient of sliding friction; Q – axial force, N.

Reduced diameter of friction pairs:

$$D_{re} = \frac{2D^3 - D_1^3}{2D^2 - D_1^2} \qquad (3)$$

where D and D_1 are the outer and inner diameters of the friction surfaces, mm.

Axial force required to engage the clutch

$$Q = \frac{2T_{fr}}{fD_{re}} \qquad (4)$$

To reduce the force Q, it is possible to increase the coefficient of friction f, for which one disk is lined with an overlay made of friction material, asbo-friction material. Such clutches run dry, so these discs are made of cast iron.

Friction clutch disks are checked for wear resistance according to the condition:

$$P = \frac{4Q}{\pi(D^2 - D_1^2)} \le [p] \qquad (5)$$

where [P] is the allowable pressure on the working surface of the coupling. In order for the wear of the discs to be sufficiently uniform, they usually take D ≤ (1.5 ... 2) D_1.

The permissible value [p] and the values of the friction coefficient f are established on the basis of operating experience, and depend on the material of the rubbing surfaces.

The contact friction force (P), according to the molecular mechanical theory of friction, is the sum of the adhesive and cohesive components. Since the interaction of these components is carried out on the actual contact area (A), then the

specific friction force (τ) can be represented as a formula:

$$\tau = \frac{F}{A_r} = \tau_a + \tau_k \qquad (6)$$

where F is the friction force at contact, (N);

τ_a and τ_k – adhesive and cohesive components, MPa.

In this case, the adhesive (τ_a) component is characterized by the dependencies :

$$\tau_a = \tau_0 + \beta_2 \sigma_n;$$
$$\sigma_n = \frac{P}{A_r} \qquad (7)$$

A_r - actual contact area, (mm²);

where τ_0 are shear stresses independent of normal ones, (MPa);

β_2 is the molecular friction constant;

σ_n is the design strength of the material, (MPa).

Based on this, the adhesive component of the friction coefficient (fa) in plastic contact can be written as

$$f = \frac{\tau_0}{HB} \beta_2 = const \qquad (8)$$

Analysis of the relationship of various parameters, in the aspect of creating a rational friction mode, it is possible to use friction discs with a positive hardness gradient (G_h), which can be represented as an inequality:

$$G_h = \frac{dH}{dh} > 0 \qquad (10)$$

Where *dH* is the microhardness distribution, (Hv);

dh is the depth of measurement of the hardness of the material, mm.

A decrease in the hardness of the surface layer under conditions of plastic contact will lead to an increase in the friction coefficient (£fr), facilitating the formation of the friction surface of friction discs with a larger actual contact area and a lower specific friction force, which will increase its bearing capacity, allowing an increase in the FM resource. However, a decrease in specific loads can lead to an increase in slippage, a decrease in the friction coefficient, a friction moment of the FM, expressed by dependence (12) and a violation of its operation mode:

$$M_\psi = Q f_{fr} R_{fr} \qquad (11)$$

where M_ψ is the friction moment of a fully engaged clutch, (Nm); R_{fr} – friction radius, (m); Q is the total axial force of the disks, (N).

Thus, from the point of view of FM resource assessment, it is necessary to consider the relationship between the friction coefficient and the hardness gradient of the working surface of the friction disc.

The general tribological law, presented in the form of expression (8), as applied to the work of FM, shows the feasibility of increasing the adhesive (F_a) component and reducing the cohesive (F_k) component of the friction force:

$$F_{fr} = F_a + F_k \qquad (12)$$

where F_{fr} – friction resistance, (N); F_a-adhesion resistance, (N); F_k - cohesive resistance, (N).

In pairing friction discs, this can be achieved either by increasing the actual contact area, or by increasing the load on the compressing discs in the contact zone [11]. The most preferable of them is an increase in the actual contact area, which is confirmed by the molecular mechanical theory of friction, according to which the friction coefficient is described by I.V. Kragelsky [10] in the form of the expression:

$$f = \frac{\alpha_2 A}{Q} + \beta_2 \qquad\qquad (13)$$

where Q is the normal contact load, N; α_2 and β_2 are the constants of the friction pair under study.

A rational way to achieve this is to modify the friction surface of FM friction disks by applying a functional coating by friction-mechanical brassing at the stage of their manufacture.

Based on the analysis of the tribological system of friction discs with a positive hardness gradient and the relationship between the parameters of the friction process, it is possible to represent the moment of friction of friction discs as a criterion for evaluating one of the parameters of the friction mode, expressed as a functional dependence of the hardness of friction pairs, the presence of lubrication, diffusion of soft materials, load on the friction couple and the temperature of the surface layer.

To conduct experimental research, we have developed an experimental setup based on the TOYOTA sewing machine with the preservation of the kinematic and operating modes of the sewing machine. The general view and block diagram of which are shown in Figures 2 and 3.
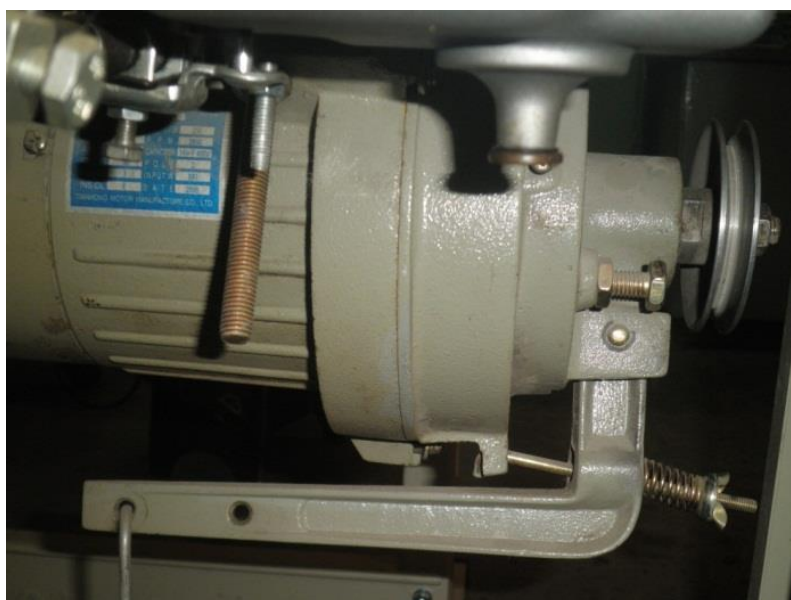

Fig.2. General view of the sewing machine drive

For experimental studies, the standard modes of operation of the sewing machine were adopted. The frequency of rotation of the main shaft of the electric motor was 3000 turn/m, with an electric motor power of 0.45 kW.
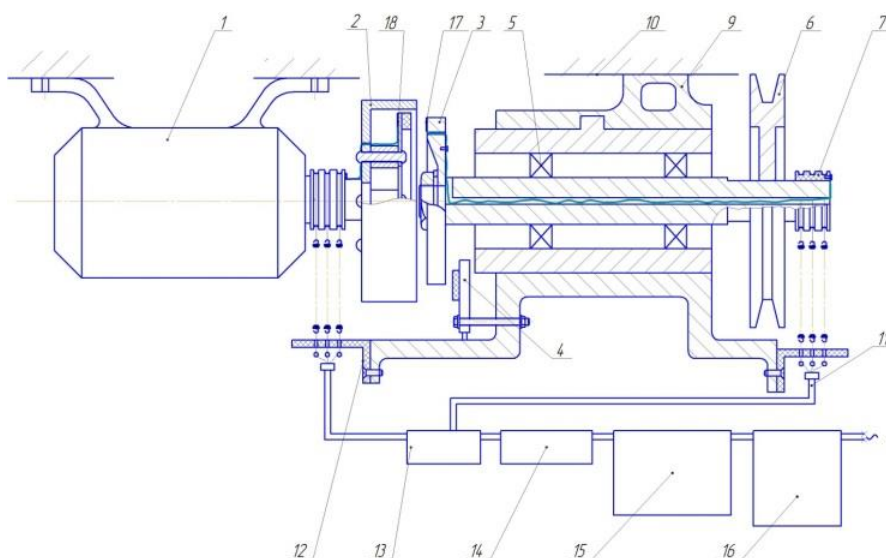
Fig.3. Scheme of the experimental setup for measuring the torque on the drive clutch of the sewing machine

1 – sewing machine drive electric motor. 2 – drive flywheel. 3-driven drive of the sewing machine. 4-brake clutch. 5 - rolling bearings for installing the driven shaft. 6 - sewing machine drive pulley. 7 – current collectors for strain gauges mounted on the driven drive shaft of the friction clutch. 8 slippers on the flywheel drive shaft. 9 – friction clutch housing. 10 - bed of the sewing machine. 11-terminals of current collectors. 12-bracket for installing current collector terminals. 13 – strain gauge amplifier UT-4-1. 14 – analog-to-digital converter LTR-154. 15 – oscilloscope and pulse modulator with a timer. 16 – computer

The ongoing research makes it possible to experimentally determine the value of the transmitted moment depending on the number of friction surfaces and various values of the compression force of the disks with the redistributed dimensions and material of the disks themselves. In addition, the results obtained can be compared with theoretical calculations and experimentally determined the coefficient of friction between rubbing surfaces.

The calculation of an additive criterion based on the results of an experimental assessment of the change in wear rate, temperature and friction torque in the interface, taking into account the change in the friction mode of the compression sleeve and the hardness of the surface layers of the friction discs, will allow us to build graphical dependencies and response surfaces, which make it possible to determine the optimal combination of the average hardness of the interface and thereby assess the impact of the proposed structural and technological changes on the service life of the friction clutch of the sewing machine.

References

1. Бабаджанов С.Х., Дустова Ф.Х. Фрикционные муфты на швейных машинах, процессы сцепления и расцепления. Молодежь и наука: шаг к успеху. Сборник научных статей 4-й Всероссийской научной конференции перспективных разработок молодых ученых. Том 5. Курск, 19–20 марта 2020 года, С. 28-32.

2. Скойбеда, А.Т. Детали машин и основы конструирования: учебник/А.Т. Скойбеда, А.В. Кузьмин, Н.Н. Макейчик; под общ. ред. А.Т. Скойбеды. – 2-е изд., перераб.. – М.: Выш. шк., 2006. – 560 с.

3. Гузенков П.Г. Детали машин: Учеб. для вузов. – 4-е изд., М.: Выш. шк., 1986. – 359 с.

4. Комиссаров А.И. и др. Проектирование и расчет машин обувного и швейного производств. – М.: 1990, 431 с.

5. Войтенко В.А. Моделирование тепловых процессов и процессов изнашивания фрикционной муфты нового типа для машиностроения. Вестник Пермского национального исследовательского политехнического университета. Машиностроение, материаловедение. – 2021. – т. 23, №4. – С. 93-101.

6. Transient processes when switching on a friction clutch on a YAMATA sewing machine S. Babazhanov, F. Dustova. 7th International Conference «Science and practice: a new level of integration In the modern world» October 28, 2018, Sheffield, UK. Conference Proceedings, Part 2.

7. Джанахмедов А.Х., Алиханов Н.Р. Вероятностные аспекты оценки фрикционных материалов на износ: Сб. научн. ст. АзИНХ. Баку, 1979, М, с. 59-61.

8. Евдокимов В.А., Колесников В.Л., Тетерин А.И. Планированиеи анализ экспериментов при решении задач трения и износа. -М.: Наука, 1980. 228 с.

9. Кордонский Х.В., Харач Г.М. и др. Вероятностный анализ процесса изнашивания. М.: Наука, 1968. 55 с.

10. Крагельский И.В., Добычин М.Н., Комбалов В.С. Основы расчетов на трение и износ. М., Машиностроение, 1977, 526 с.

11. Щеренков Г.М., Галягин В.А., Абрамова Т.А. Развитие конструкций однодисковых муфт сцепления: Экспресс-информация ЦНИИГЭИтракторосельхозмаш. М., 1983, вып.14. - 42 с.

IMPROVEMENT OF THE DESIGN OF THE SHUTTLE DRUM IN THE SEWING MACHINE

VAFAYEVA ZAMIRA

Doctoral student of Bukhara of Engineering Technology Institute
E-mail: vafayeva1982@mail.ru, phone.: (+99891) 312-48-84

MATYAKUBOVA JUMAGUL

Assistant of Urgench State University

MANSUROVA MUNISA

Associate professor of Tashkent of Textile and Light Industry Institute

Abstract:

Objective. Today, in the process of sewing gauze, the lack of the ability to untie the shuttle thread, to ensure its tension evenly, is considered a disadvantage of this shuttle tube design. our goal is to improve the new construction of the shuttle bobbin in the sewing machine.

Methods. The experiment was carried out on sewing machines of "Shafirkon equatorial" enterprise. the structural scheme and working principles of the component tube with elastic bushing and plastic fingers were studied. a tube winder with a base, frame, guide wheel, tube, hook mechanism, thread tension mechanism and thread trimming mechanism in a sewing machine, along with recommendations for improving productivity.

Results. According to the results, a new effective structure of the component tube was developed. based on theoretical studies, a formula was obtained to determine the friction between the winding thread and plastic fingers.

Conclusion. The article provides a structural diagram and the principle of operation of a composite bobbin with an elastic sleeve and plastic sticks. An analytical method is given for determining the moment

of friction between the unwinding thread and the plastic sticks of the rubber bushing in the sewing machine, based on the analysis of the constructed graphical dependencies, the main parameters of the recommended bobbin design in the sewing machine.

Keywords. Sewing machine, bobbin, rubber sleeve, thread, friction, force, moment, plastic stick, radius, coefficient, grooves, pitch, stiffness, deformation, pressure, tension.

Introduction. In double-thread stitch sewing machines, the threads that fall into the sewing zone have a certain margin. At the same time, the bobbin thread is pre-wound on the bobbin [1].

A well-known bobbin design, consisting of two round disks rigidly interconnected by a sleeve [1, 2].

The disadvantage of the known design is the impossibility of providing a uniform tension of the bobbin thread during its unwinding in the process of stitching materials. When unwinding the thread from the bobbin, depending on the location of the current turn of the thread with a change in the radius of its location, a variable unwinding force is required. At the very beginning of the unwinding of the thread, the coil on the bobbin is located at a large radius of the bobbin and therefore a small traction force is required to unwind it, and when the thread is used up at the very end, the radius of the last turns is practically in the bobbin at a radius equal to the outer radius of the bobbin sleeve. At the same time, a large pulling force is required to unwind these last turns of thread from the bobbin.

To ensure the uniformity of the tension of the shuttle thread during their unwinding, that is, when grinding materials, the design of the bobbin winder was improved [2,3].

Bobbin winders for a sewing machine, containing a base, a frame, a wired wheel, a bobbin, a latch mechanism, a thread tension mechanism and a thread cutting mechanism, are not reliable in operation and have low productivity.

A bobbin winder for a sewing machine containing a base, a frame, a wired wheel, a bobbin, a latch mechanism, a thread tension mechanism and a cutting mechanism, while in order to increase productivity, the thread tension mechanism is made in the form of a square, one of the shelves of which has a thread guide slot, and the thread cutting mechanism is made in the form of a slider with a striker coming out and a hole at the end of the bobbin winding [3].

The disadvantage of these bobbin winders for the sewing machine is the complexity of the design and the impossibility of ensuring uniform tension of the bobbin thread when it is unwound during the grinding of materials due to the lack of a means of regulating the tension of the thread in the bobbin with a gradual decrease in the radius of the turns.

In the design of the sewing machine 852 class PMZ [4], the bobbin consists of two side round disks rigidly connected to each other by means of a metal sleeve. The defect of this design is also the impossibility of ensuring the uniformity of the tension of the shuttle thread both during their winding and unwinding.

To ensure the uniform tension of the bobbin thread during its winding and unwinding from the bobbin, allowing a significant reduction in thread breakage and an increase in the productivity of the machine, improving the design of the bobbin equipped with an elastic element. [5].

Methods. Efficient construction of a compound bobbin for a sewing machine. The essence of the design lies in the fact that the bobbin for the sewing machine contains two side round disks rigidly connected to each other by means of a metal sleeve, to which a rubber elastic sleeve is put on. Plastic sticks with a certain pitch are installed on the surface of the rubber bushing. In this case, the stick enters the groove of the rubber bushing for half the thickness, and the rest (the second half of the thickness) protrudes outward from the rubber bushing. This allows, in the

process of winding the bobbin thread, uniform tension in the turns over the entire thickness of the wound thread. This is also ensured in the process of unwinding the thread.

The design of the bobbin for the sewing machine consists of two side round disks 1 and 2, rigidly connected to each other by means of a metal sleeve 3. A rubber sleeve 4 is put on the sleeve 3, which has grooves along the outer surface with a certain depth and pitch. Plastic sticks 5 are installed on the grooves of the rubber bushing 4, while part of the sticks 5 protrude from the surface. Along the edges of the rubber sleeve 4 has protruding parts 6 equal in height to the sticks 5. (Figure 1 A)
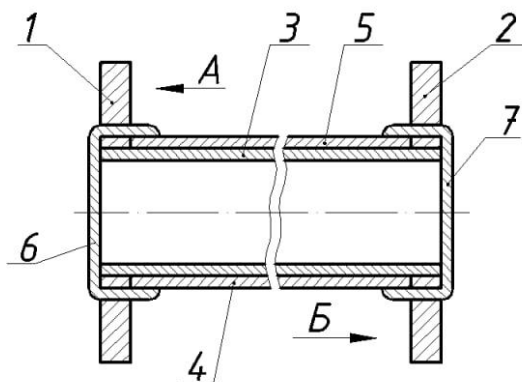

Figure.1 A. The rubber sleeve 4 has protruding parts 6 equal in height to the sticks 5

The design works as follows. The bobbin thread is wound on a rubber bushing 4 with plastic sticks 5. At the same time, due to the tension of the thread, the rubber bushing 4 is deformed. With an increase in the number of screws, the thickness of the wound thread, the deformation of the rubber bushing increases. At the end of the winding of the thread, the rubber sleeve 4 will be in a deformed state. At the same time, with the beginning of the operating mode, the bobbin thread is unwound gradually, cyclically. At the same time, due to the exposing force of the deformed rubber sleeve 4, by means of plastic sticks 5, the thread can be unwound and leads to equalization of its tension. Plastic sticks 5 do not allow the introduction of turns of thread into the rubber sleeve 4. By choosing the appropriate brand of rubber, the parameters of the sticks 5 and the rubber sleeve 4, you can provide the required modes of winding and unwinding the bobbin.

The design of the bobbin for the sewing machine ensures uniform tension of the bobbin thread during its winding and unwinding, leading to a decrease in thread breakage, to an increase in the speed of the machine.

Calculation scheme and method for determining the friction between the unwinding thread and plastic sticks of the rubber bushing of the bobbin. Figure 2 shows the design scheme of the bobbin to determine the moment of friction between the thread and the fingers of the bobbin. According to the design scheme, the circumference of the passage ... through the outer surfaces of the sticks 3 bobbins:

$$2\pi R = ak + tk = k(a + t) \qquad (1)$$

where, a, t- is the width of the plastic stick and the distance between ... sticks, k- is the number of sticks, from (1) we can determine [6,7]:

$$k = \frac{2\pi R}{a+t} \qquad (2)$$

At the same time, the thread pressure force 1 on the outer surfaces of the plastic

sticks is composed of the distributed thread pressure force, which depends on the thread tension force, as well as the elastic force of the rubber bushing when winding on the bobbin.
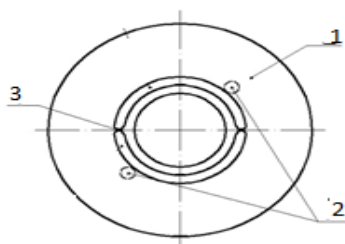

Figure.2. Scheme of the interaction of the thread and plastic sticks

At the same time, due to the relative smallness of the weight of the thread, it can write [8,9]:

$$P = aklq + c\Delta k$$
$$F_{tr} = fr; \quad M_{fr} = fRP \qquad (3)$$

where, R is the radius of the outer circle passing through the outer surfaces of the plastic sticks; C is the stiffness coefficient of the rubber bushing, Δ. is the average value of the deformation of the rubber bushing, is the length of the plastic sticks; q-distributed value of thread pressure 1 on plastic sticks 3; F_{tr} is the force of friction between the thread 1 and the surface of the stick 3; M_{fr} is the moment from the friction force; f is the coefficient of friction between the thread and the plastic surface.

Taking into account (2), (3), we obtain an expression for determining the moment of friction force between thread 1 and plastic sticks 3 in the bobbin in the form [10]:

$$M_{fr} = \frac{6.28\,fR}{a+t}\,(alq + c\Delta) \qquad (4)$$

Results. Numerical solution and analysis of results. Based on the solution of the problem, taking into account the given parameters of the composite bobbin of the sewing machine, their graphic dependencies were built. Figure 3 shows the graphical dependences of the change in the moment of friction between the thread and the surfaces of the sticks on elastic bases on the change in the distributed load due to the change in the tension of the thread. An analysis of the graphs in Figure. 3 shows that with an increase in the distributed load, the plastic sticks of the bobbin from the thread wound around them in a nonlinear way naturally increase the moment of friction forces between them. Thus, with increasing load from 7.1 Ce/mm^2 to 21.5 Ce/mm^2 at f=0.08, the value of M_{fr} increases from $1.54 \cdot 10^{-2}$nm to $1.45 \cdot 10^{-2}$nm. When the value of the coefficient of friction between the thread and plastic sticks is 0.15, the value of the moment of friction increases from $0.96 \cdot 10^{-2}$ nm to $3.18 \cdot 10^{-2}$nm. It should be noted that the greater the friction moment M_{fr} between the thread and plastic sticks, the more the possibility of unwinding the thread in the bobbin is reduced. In this case, to unwind the thread from the bobbin, some initial thread tension is required.
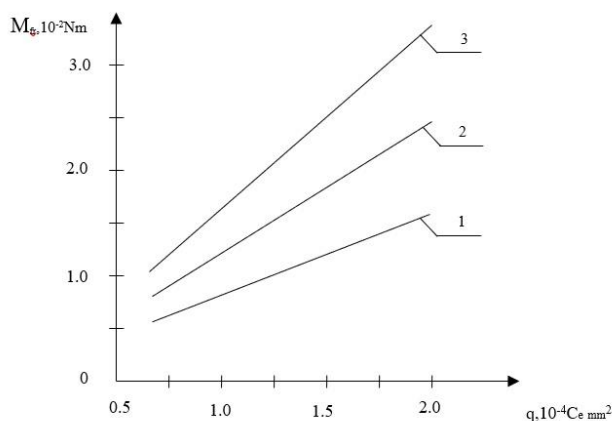
1-f=0.08; 2-f=0.12; 3-f=0.15

Figure.3. Graphic dependences of the change in the moment of friction between the thread and the surfaces of the sticks on elastic bases on the change in the distributed load due to the change in the tension of the thread

This is especially true when stopping and starting the grinding process. With a sharp stop of the grinding process at a small value of the friction moment M_{fr}, self-unwinding of the thread by inertia can occur. Therefore, for linvidation, self-winding of the thread, as well as maintaining the required values of the tension of the shuttle thread in the sewing machine, the recommended load values are $q=(1.8÷2.2) \cdot 10$ Ce/mm^2, at which $M_{fr} \geq (1.8÷3.1) \cdot 10^{-2}$ nm.

In this case, the stiffness of the rubber base of the bobbin is important. It should be noted that the greater the rigidity of the rubber bushing of the bobbin, the greater the value of M_{fr} between the thread and the plastic sticks. Figure 4 presents. From the analysis of the constructed graphical dependencies in Figure. 4, it was revealed that with an increase in the coefficient
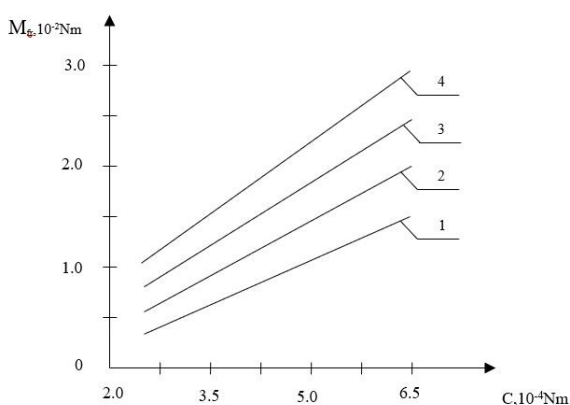
1-q=7.5 Ce/mm^2; 2- q=12 Ce/mm^2; 3- q=15 Ce/mm^2; 4- q=18 Ce/mm^2;
Figure.4. Graphical dependences of the change in the moment of friction between the thread and the surface of the sticks on elastic bases on the change in the stiffness coefficient of the rubber bushing of the composite bobbin

The stiffness of the rubber bushing of the bobbin at q=7.5 Ce/ mm^2, the M_{fr} value increases in linear dimension from $0.35 \cdot 10^{-2}$ nm to $1.49 \cdot 10^{-2}$ nm.

With a load value $q=18$ Ce/mm^2 with an increasing value of the stiffness coefficient of the rubber bushing from $2.81 \cdot 10^{-4}$nm to $6.5 \cdot 10^{-4}$n/m the friction moment between the thread and the plastic sticks increases linearly from $1.07 \cdot 10^{-2}$ nm to $2.87 \cdot 10^{-2}$nm.

To ensure the moment of friction between the wound thread and plastic sticks within the limits of $M_{fr} \geq (1.8 \div 3.1) \cdot 10^{-2}$nm, the recommended values of the stiffness coefficient of the rubber bushing of the bobbin are. $C=(5.45 \div 6.65) \cdot 10^{-4}$ n/m.

It is known that the larger the contact area of the thread with plastic sticks, the greater the moment from friction forces in this kinematic pair [10,11]. In order to ensure the required area of contact between the thread and plastic sticks, it is considered advisable to increase the number of sticks, the value of the distance between the sticks, or increase the reduction width of the sticks at a certain. Therefore, it is important to consider justified values of the distance "t". Figure 5 shows. Graphic dependences of the change in the moment of friction between the thread and plastic sticks on elastic bases on the change in the distance between adjacent bobbin sticks.

Discussion. The analysis of the constructed graphic dependences in Figure. 5 shows that an increase in the distance between adjacent plastic sticks from $2.85 \cdot 10^{-3}$m to $5.5 \cdot 10^{-3}$m at $R=5.5 \cdot 10^{-3}$m also leads to equipping the friction moment along a linear regularities from $1.62 \cdot 10^{-2}$nm to $0.36 \cdot 10^{-2}$nm. This is explained by the fact that with an increase in R values, the number of plastic sticks also decreases, thereby reducing the contact area of the thread with plastic sticks. This leads to a decrease in the values of the friction moment. Radius increase up to $8.5 \cdot 10^{-3}$m, friction moment decreases from $2.26 \cdot 10^{-2}$nm to $0.97 \cdot 10^{-2}$nm. To ensure the required values of the friction torque between the thread and plastic sticks within $(1.8 \div 3.1) \cdot 10^{-2}$nm, the recommended values for the distance between adjacent plastic sticks are $t \leq (3.3 \div 4.2) \cdot 10^{-3}$m.

Conclusion. A new efficient design of the compound bobbin has been developed

1-R=$5.5 \cdot 10^{-3}$ m; 2-R=$7.0 \cdot 10^{-3}$m; 3-R=$8.5 \cdot 10^{-3}$m;

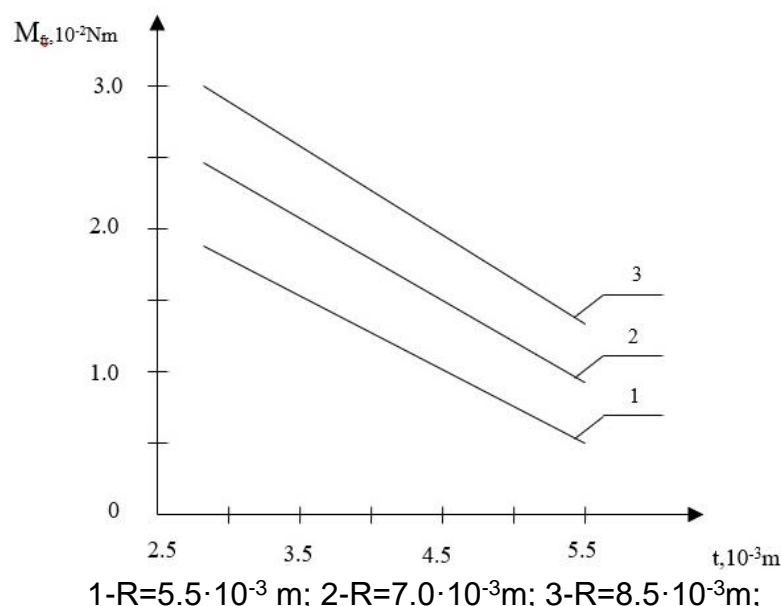**Figure.5. Graphic dependences of the change in the moment of friction between the thread and plastic sticks on elastic bases from the change in the distance between adjacent sticks of the bobbin for the bobbin thread in the sewing machine. On the basis of theoretical studies, a formula was obtained for determining the friction between the wound thread and plastic sticks. The parameters of the compound bobbin are substantiated**

References

1. Chervyakov F.I., Sumarokov N.V. Sewing machines, M. "mechanical engineering", 1968, page 472

2. Savostitsky A.V., Melikov E.Kh., Kulikova I.A. Sewing technology. M. "Light industry", 1971, page 568

3. Bobbin winder for a sewing machine, Copyright certificate No. 303385, Bull.

4. Frants V.Ya., Isaev V.V. Sewing machines, M. "Legprombytizdat",1986, pages 29-34

5. Vafaeva Z.S. Global challenges of innovative science. proceedings "Bobbin for a sewing machine"March 06, 2022 pages 49-53

6. Design and methods of calculating parameters of a fibrous material cleaner from large litter Anvar.D., Kuliev T.M. International Journal of Advanced Science and Technology this link is disabled, 2020, 29 (8 Special Issue), pages 444-452

7. Development of an effective resource-saving design and methods for calculating the parameters of gears with compound wheels Djurayev A., Beknazarov J.K., Kenjaboyev S.S. International Journal of Innovative Techology and Exploring Engineering this link is disabled, 2019, 9 (1), pages 2385-2388

8. Teoretiko-experimental method of definition of parameters of the roller with the rubber plug of the device for drawing of the polymeric composition on lines of sewed materials Behbudov S.H., Djuraev A.D, Amonov A.R., Qodirova D.X. International Journal of Innovative Technology and Engineering this link is disabled, 2019. 9 (1). pages 2069-2074

9. Development of desing and substantiation of the parameters of the separator for fibrous materials Khojiev M.T., Juraev A.D, Murodov O.D., Rakhimov A.K. International Journal of recant Technology and Engineering this link is disabled 2019, 8 (2), pages 5800-5811

10. Analysis of the interaction of fibrous material with a multifaceted grid of the cleaner Anvar J., Ozod. International Journal of recant Technology and Engineering this link is disabled 2019, 8 (1), pages 2661-2666

PREPARATION OF A NEW STRUCTURE CREATED FOR SORTING OF GINNING SEEDS

OBIDOV AVAZBEK

Professor of Namangan Institute of Engineering and Technology
E-mail: aobidov@list.ru, phone: (+99893) 941-77-75

VOKHIDOV MUKHIDDIN

Researcher of of Namangan Institute of Engineering and Technology
E-mail: mvokhidov@gmail.com, phone.: (+99895) 002-78-89

Abstract: This paper researches a pilot copy of a seed sorting device with an improved design. In addition, this article has conducted theoretical and practical studies to determine the effectiveness of seed selection. As a result of these studies, the operating mode of the new construction was determined and the parameters for its effective operation were developed. The geometric parameters of the developed sorting device are recommended for use in the production copy.

Keywords. Seeds, ginning, cotton, cotton fiber, sorting, cleaning, seed fractions, technology, efficiency, spinning, quality, mesh surface.

Introduction. It is known that in many studies [1-4] it was noted that seeds with different fiber content are included in the mass of seeds after the ginning process. In addition, it is clear to many researchers that the mass contains various impurities, broken and damaged seeds, and clean seeds (not necessarily sent to the linter) [5-6]. Previous studies [7-8] have recommended sorting the ginned seeds, returning them to the gin machine, transferring them to the linter battery, sending them to the seed storage and discarding them, respectively, and this has been done using a single technology [9-11].

In this work, the results of the scientific-research works carried out in this direction until now have been deeply analyzed. As a result, the advantages and disadvantages of the created devices were identified and research directions were selected. Taking into account the main shortcomings of the devices designed for sorting or cleaning the dried seeds, a new device scheme was developed for practical research (Fig. 1).

Based on the analysis of the conducted researches, it was determined that it is necessary to improve the technologies that provide the opportunity to improve the quality of lint and increase the production of fibers suitable for spinning in cotton ginning enterprises, in order to increase their efficiency, the accuracy of seed sorting, and to ensure their ecological safety. solution was selected as a main focus for further research [12].
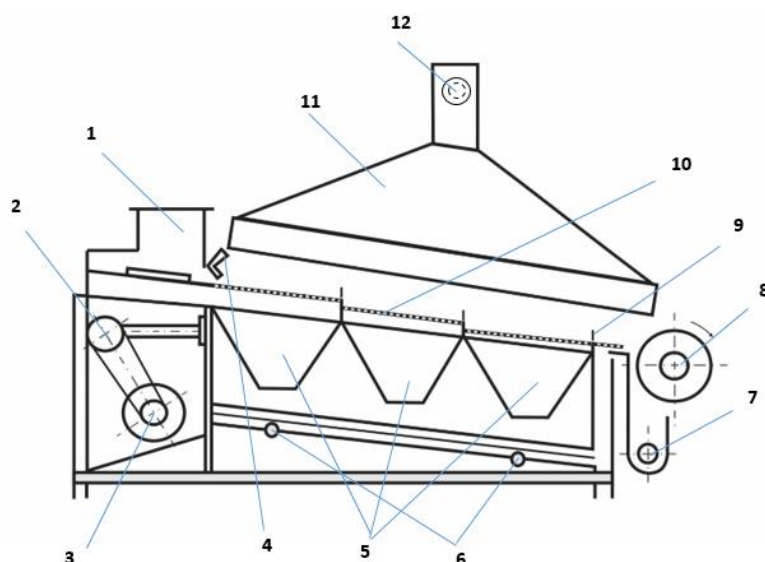
Here are 1 inlet pipe, 2 eccentric shaft, 3 electric motor, 4 rubber limiter, 5 hoppers into which seed fractions fall, 6 bearings, 7 dirt auger, 8 saw drum separating long fiber seeds, 9 digging piles , 10-oscillating mesh surface and 11-air intake shell, 12-air intake fan

Figure 1. Technological scheme of the improved sorting device

When this device works, the seeds come to the mesh surface 10 through the inlet pipe 1, and here they start to move along the sections separated by the piles 9. Since the width of the surfaces that make up the mesh surface of the sections increases from the beginning to the bottom, the seeds begin to be sorted according to their fiber. The mesh surface 10 receives the vibration from the eccentric shaft 2 driven by the engine 3, and bearings 6 are placed under the surface carriage to create amplitude. A small fan 12 is mounted on top of the shell 11 to trap and expel dust.

In the technological process of cotton processing, it is necessary to create a

device that captures fractions that are not well ginned, and it requires a theoretical study of the exit of these fractions from a normally functioning gin.

In [13], it was proved that there are two types of residual fibers in the ginning cotton seeds, which are loosely bound fibers and fibers that have not yet been completely separated from the seeds by sawing. The reason for the appearance of free fibers is the large difference in the rotation speed of the raw material roller and the saw cylinder. In order to prevent the causes of this formation and not to damage the seeds, in order to completely retain the fibers in the raw material shaft in the imperfectly formed process, the non-formed fractions should be additionally crushed and directed to the teeth of the saw cylinder.

The amount of free fibers and incompletely ginned seeds from gin depends not only on its normal functioning, but also on a number of other factors.

These conditions can be caused by the following: high humidity of raw cotton; failure to replace saw cylinders or damaged teeth, individual saws on time; malfunction or lack of piles in seed combs [14-16].

The preparation of unginned fractions, as well as the choice of technology and their further processing, require the distribution of cotton seeds according to the degree of shrinkage and the knowledge of the content of free fibers, which are underestimated in them after ginning [17-18]. For this purpose, we selected 200 seeds for research from a fractional batch selected after a normal working gin under the production conditions of a cotton gin, and this experiment was repeated until 95% of results were obtained. The fibers in the selected fractions were divided into 7 groups according to their length, and the results were measured. The measurement results are presented in Table 1.

Table 1

The length of fibers present in ginseng seeds

№	Lint and fiber length, mm						
	0-5	5-10	10-15	15-20	20-25	25-30	30-35
1	30	77	67	17	3	3	3
2	34	55	72	16	5	4	4
3	35	67	65	19	6	5	3
4	33	74	61	21	4	3	4
5	39	65	71	13	5	4	3

Methods. We use the following formula:

$$P(X, \leq \xi \leq X_2) = -\Phi\left(\frac{X_1 - \bar{X}}{\sigma}\right) + \Phi\left(\frac{X_2 - \bar{X}}{\sigma}\right) \qquad (1)$$

Let's look at the first interval:

$$P_1 = P(0 \leq \xi \leq 3) = -\Phi\left(\frac{6-10,26}{6,0811}\right) + \Phi\left(\frac{3-10,26}{6,0811}\right) = \Phi(-1,6872) + \Phi(0,8649) =$$
$$-0,0465 + 0,1949 = 0,1484 \qquad P_1 = 0,1484$$

$$P_2 = \Phi\left(\frac{10-10,26}{6,0811}\right) - \Phi\left(\frac{6-10,20}{6,0811}\right) = \Phi(-0,0428) - \Phi(0,8649) = -0,0499 - 0,1939 =$$
$$0,3050 \qquad P_2 = 0,3050$$

$$P_3 = \Phi\left(\frac{15-10,26}{6,0811}\right) - \Phi\left(\frac{10-10,20}{6,0811}\right) = \Phi(-0,7795) - \Phi(0,0125) = 0,7623 - 0,4920 =$$
$$0,2006 \qquad P_3 = 0,2903$$

$$P_{4=}\Phi\left(\frac{20-10,26}{6,0811}\right) - \Phi\left(\frac{15-10,20}{6,0811}\right) = \Phi(1,60) - \Phi(0,7795) = 0,9432 - 0,8320 = 0,1132$$

$P_4=0,1132$

$$P_{5=}\Phi\left(\frac{25-10,26}{6,0811}\right) - \Phi\left(\frac{20-10,20}{6,0811}\right) = \Phi(2,3239) - \Phi(1,600) = (1 - 0,0237) - 0,0452 =$$

$0,9763 - 0,9452 = 0,0311$ $\qquad P_5=0,0311$

$$P_{6=}\Phi\left(\frac{30-10,26}{6,0811}\right) - \Phi\left(\frac{25-10,20}{6,0811}\right) = \Phi(3,246) - \Phi(3,3239) = (1 - 0,0007) =$$

$(1 - 0,0072) = 0,0013 = 0,0026 - 0,0065$ $\qquad P_6=0,0065$

$$P_{7=}\Phi\left(\frac{35-10,26}{6,0811}\right) - \Phi\left(\frac{30-10,20}{6,0811}\right) = \Phi(4,0663) - \Phi(3,2460) = (1 - 0,000) =$$

$(1 - 0,0047) = 1 - 0,0033 = 0,0047$ $\qquad P_7=0,0047$

To calculate values

$$\Phi(X_i) = \frac{1}{\sqrt{2\pi}} \int^{xi} l^{\frac{t^2}{2}} dt \qquad (2)$$

taking the formula, $\Phi(X_i)$ when calculating the value, the table of values with the calculation of Laplace's normative functions was used [19].

Here, P_i is the theoretical data representing the probability of failure of the seeds.

$\sum P_i$ - these probability estimates obey the general normal distribution law.

P_i	$\sum P_i$
$P_1 = 0,1484$	0,1484
$P_2 = 0,3050$	0,4534
$P_3 = 0,2903$	0,8437
$P_4 = 0,1132$	0,9569
$P_5 = 0,0311$	0,9880
$P_6 = 0,0065$	0,9945
$P_7 = 0,0047$	0,9992

Column 16 of Table 2 shows the difference between empirical and theoretical distribution functions, namely:

$$D = |F_n(X) - F(X)| \qquad (3)$$

Results. It is necessary to check the hypothesis about the compliance of the observed phenomenon with the normal law [20] according to the criteria of scientific work. According to this criterion, it will have a very strict significance level – *P*=0,2.

In this case $D =0,0569$; $n =200$.

$$\lambda = D\sqrt{2} = 0,0569\sqrt{200} = 0,0569 \cdot 14,142 = 0,8047 \ \lambda = 0,8047$$

Table 2

Results of the interval study

Lint class by length	Interval	The center of the fiber interval	(1) n_i	(2) n_i	(3) n_i	(4) n_i	(5) n_i
1	2	3	4	5	6	7	8
1	0-5	2,5	30	34	36	33	39
2	5-10	7,5	77	65	67	74	65
3	10-15	12,5	67	72	65	61	71
4	15-20	17,5	17	16	19	21	13
5	20-25	22,5	3	5	6	4	5
6	25-30	27,5	3	4	5	3	4
7	30-35	32,5	3	4	3	4	3

Table 2 continued

Average n_i	n_i/n	$\sum n_{i/n}$	$X_{\text{ўрт}}\, n_i/n$	σ^2	P_i	$\sum P_i$	$EP_i \sum n_{i/n}$
9	10	11	12	13	14	15	16
33	0,164	165	0,4054	10,55	0,1484	0,1484	0,0166
62	0,31	0,475	2,318	3,08	0,3050	0,4534	0,0216
63	0,345	0,835	4,304	1,33	0,2303	0,8437	0,0077
24	0,12	0,4562	2,039	4,45	0,1132	0,9569	0,0007
7	0,035	0,975	0,078	3,74	0,0311	0,9800	0,0150
3	0,015	0,99	0,48	3,9	0,0065	0,9945	0,0045
2	0,01		0,32	7,41	0,0047	0,9992	0,0008

λ_Φ we get the following according to the table for [20]:

$$\lambda_{0,8} = 1,07 \ ie \ \lambda < \lambda_{0,8}$$
$$(0,8016 < 1,07)$$

Therefore, according to the hypothesis of the normality of the distribution law of the determined fractions, they should have been lintered twice downwards. In our case, the parameters of the normal distribution are as follows:

$$a = \bar{X} = 10,26, \quad \sigma = 6,0811$$

i.e., the probability of a cotton blend being separate can be studied separately for certain fractions.

In order to improve the quality of the produced lint and increase the fiber output, the task of studying the fractional composition of the ginned seeds depending on their fiber content and residual fiber level is set.

We considered the issue of the distribution of demonized seeds in the following fractions:

- regenerating seeds;
- twice-lintered fractions;
- single linter fractions;
- non-linter seeds.

For this purpose, we conducted studies and analysis of ginned seeds and their fiber content and residual fiber in several cotton ginning enterprises. In this case, the output of fractions after sorting: single- and double-lintered seeds, and fiber seeds, which should be re-sintered, made it possible to determine the homogeneity of the formation.

The range of the amount of distribution by seeds is equal to:

$$R_e = Q_{\text{кат}} - Q_{\text{кич}}$$
$$(4)$$

Here $Q_{\text{кат}}$ ва $Q_{\text{кич}}$ - the largest and smallest amount of seeds included in a given fraction.

Now let's consider the range of the distribution of seed fractions for seeds prone to double linter at different values of gin productivity:

a) minimum productivity $Q_1=7.4$ kg/saw hour

b) average productivity $Q_1=9.5$ kg/saw hour

c) maximum productivity $Q_1=12.2$ kg/saw hour

Q_1

100	108	105	106	107	108	109	110	112	113	115	118	119
1	1	1	1	1	2	5	1	2	2	1	1	1

Q_2

107	108	109	111	112	115	116	117	119	120	121
1	2	3	2	3	3	1	1	2	1	1

Q_3

112	115	116	117	118	119	121	123	124
1	1	2	5	4	3	2	1	1

The interval for the distribution of fractions will be equal to:
a) Rmin=19; b) Ror=14; c) Rmax=12
We find the arithmetic mean using the following formula:

$$\bar{C} = \sum_{i=1}^{n} C_i q_i / \sum_{i=1}^{n} q_i \qquad (5)$$

a) $\bar{C}_{min} = 109{,}7$; b) $\bar{C}_{\ddot{y}p} = 113{,}25$; c) $\bar{C}_{max} = 116{,}1$

In that case, exclusion $\Delta \bar{C}_i$ a group of seeds prone to double linters $\bar{C}$ in terms of average value is the following:

$$\Delta C = C_i - C$$

From this we find the mean square constraint:

$$\delta = \sqrt{\sum_{i=1}^{Q_n} (C_i - \bar{C})^2 \frac{q_i}{2C}} \qquad (6)$$

a) $\delta_{min} = 4{,}42$; b) $\delta_{or} = 4{,}25$; c) $\delta_{max} = 2{,}65$

Conclusions. We proved that the distribution of random variables (the number of double linter seeds) obeys the normal distribution law. Using it, it is possible to determine the probability density of the number of seeds that will be lintered twice, that is:

$$y = \frac{1}{S\sqrt{2\pi}} \cdot exp\left\{\frac{\Delta C}{2S^2}\right\} \qquad (7)$$

Now we calculate the Laplace functions, taking into account the following:

$$Z_i = \frac{\Delta C_i}{S}$$

a) Q_1

Z_1	Z_2	Z_3	Z_4	Z_5	Z_6
-2,1946	-1,5158	-1,0639	-0,6371	-0,6109	-0,3846

Z_7	Z_8	Z_9	Z_{10}	Z_{11}	Z_{12}	Z_{13}
-0,1584	0,06787	0,3264	0,7468	1,1991	1,8778	2,1041

b) Q_2

Z_1	Z_2	Z_3	Z_4	Z_5	Z_6
1,4705	-1,2559	-1,0	-0,5294	-0,2941	0,4118

Z_7	Z_8	Z_9	Z_{10}	Z_{11}
0,6770	0,5824	1,2924	1,5882	1,8235

c) Q_3

Z_1	Z_2	Z_3	Z_4	Z_5	Z_6
-2,3019	-1,1698	-0,7924	-0,4151	0,0377	0,3396

Z_7	Z_8	Z_9
1,0943	1,8491	2,2265

a) Q_1

a)
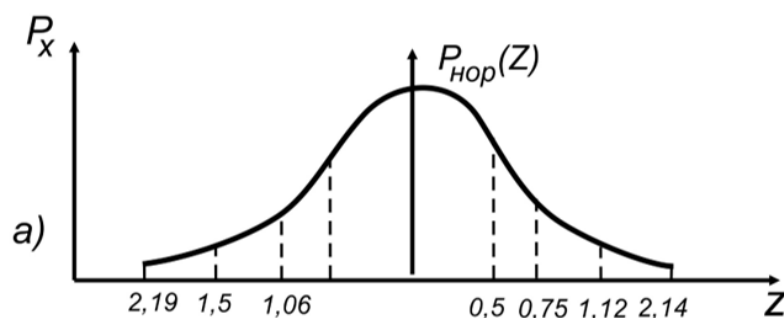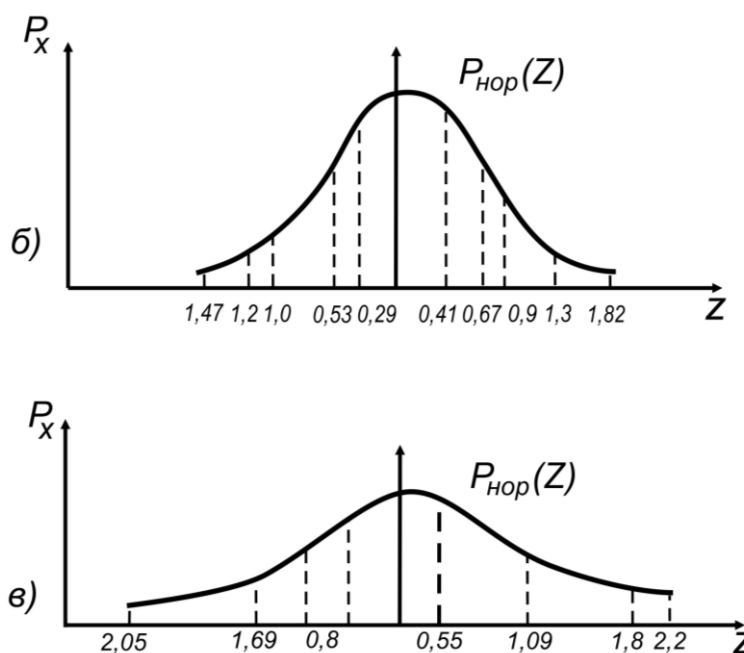
Figure 2. Limits of permissible fluctuations for seeds prone to double linters

$$\Phi_0(Z_1) = \Phi_0(-2{,}1916) = -\Phi_0(2{,}1946) = -0{,}4861$$
$$\Phi_0(Z_{13}) = \Phi_0(2{,}104) = 0{,}4821$$

b) Q_2

$$\Phi_0(Z_1) = \Phi_0(-1{,}4705) = -\Phi_0(1{,}4705) = -0{,}4292$$
$$\Phi_0(Z_{11}) = \Phi_0(1{,}8235) = 0{,}4656$$

c) Q_3

$$\Phi_0(Z_1) = \Phi_0(-2{,}3019) = -\Phi(2{,}3019) = -0{,}4893$$
$$\Phi_0(Z_9) = \Phi_0(2{,}2265) = 0{,}4868$$

Permissible fluctuation limits of the number of seeds to be lintered twice are given in Fig. 2.

References

1. Obidov A., Mamatqulov O., Sultonov M. Theoretical analysis of the movement of Cotton piece on the slope surface. International conference, 27.04.2018, Berlin, 151-156.

2. A.Obidov, Kh.Akhmedhodjaev, O.Sarimsakov, Q.Holikov. Investigation of the Properties of Fibrous Cotton Seeds, for Sorting on a Mesh Surface. Engineering, 2018, 10, 572-578.

3. Биргер И.А. Прочность. Устойчивость. Колебания. Москва, 2012, 567 с. (https://www.ozon.ru/publisher/kniga-po-trebovaniyu-5297160/)

4. Полякова Д.А. и др. Отходы хлопчатобумажной промышленности. // Справочник.. – М.: Легпромбытиздат, 1990. - 208 с.

5. Obidov A.A., Sultanov M., Mamatkulov O. Study of the dependence of their characteristics on the processing of ginned seeds. FarPI scientific and technical magazine, Special issue, No. 3, 2018, pp. 22-27.

6. Birger I.A. Strength. Sustainability. Fluctuations. Moscow, 2012, 567 p. (https://www.ozon.ru/publisher/kniga-po-trebovaniyu-5297160/)

7. Polyakova D.A. etc. Waste of the cotton industry. // Directory .. - M .: Legprombytizdat, 1990. - 208 p.

8. Akhmedkhodzhaev Kh.T. other. Investigation of the process of impact interaction of cotton seeds // Cotton industry. 1992. No. 5-6.

9. Novitsky I.I. Some physical and mechanical properties of cotton seeds. – Oil and fat industry. 1964. No. 5.

10. Akhmedkhodjaev H.T., Yakubov D., Obidov A.A. Ways of sorting fiber seeds after the ginning process. // Collection of articles of NamMII international scientific and practical conference. - Tashkent, 2002. - p. 389-392.

11. Akhmedkhodzhaev Kh.T., Boyturaev U.G., Tajibaev M.A. Probability of seeds coming out of a genie with varying degrees of hairiness. - T .: 1993. - 29 p. - Dep. in UzNIINTI No. 1451-Uz.

12. Isakhanov Kh.I. Study of the process of regeneration of under-ginned cotton seeds before lintering and the creation of a device for its implementation: Dis. … cand. tech. Sciences. - Tashkent: TITLP, 1986.- 243 p.

13. Akhmedkhodzhaev Kh.T., Karimov A.I., Obidov A.A. Study of the vibration movement of cotton seeds on vibrating carriages of parallel ossonation. // Journal of Textile Problems. - Tashkent, 2003. - No. 4. - P.65-67.

14. Obidov Avazbek, Sultonov Mirzaolim, Muhksinov Ibrohim, Abdullaev Shokir. The Theoretical Studies of the Cultivation of Three Cotton Seeds along the Plain. Engineering

Vol.10 No.08(2018), 514-520 P.

15. A.A.Obidov M.M.Sultanov. To research the method of separating fibers suitable for spinning on a needle drum. International scientific and practical conference CUTTING EDGE-SCIENCE. June 29-30, 2020 Shawnee, USA, 128-131 P.

16. Sultonov M.M. Obidov A.A. Study of fiber motion in a needle drum fiber separation device. Universum: Technical science, 5-74, 33-37 P.

17. Mirzaolim Sultanov, Avazbek Obidov. Investigation of working parts of fixed device designed to separate spinning fibers from fibrous waste that can be spun. Journal of Critical Reviews, JCR. 2020; 7(4): 2314-2322, doi: 10.31838/jcr.07.04.362, 5614-5623 P.

18. Obidov A.A. Investigation of the working surface of a new seeding machine // Journal of Textile Problems. - Tashkent: TITLI, 2006. - №2. - 29-32 p.

19. Avazbek Obidov, Muhiddin Vokhidov, Jahongir Abdurahmonov. Exploring the Efficiency of Experimental Construction of Sorting Ginned Cotton Seed Machine. Engineering, Scientific Research Publishing. Vol.13 No.1, January 2021.

20. Obidov A.A. Improvement of the technology of cleaning and sorting of ginned seeds. Dissertation of Candidate of Technical Sciences. - Tashkent: TITLI, 2007. - 200 p.

CARRYING OUT THEORETICAL STUDIES OF THE COTTON REGENATOR

MAMAJANOV SHAVKATJON

Namangan Institute of Engineering and Technology
Phone.: (+99894) 590-45-50

Abstract: In this paper, it was determined the strength of a newly installed slatted drum shaft by improving the design of the regenerator and conducting experiments on it. Based on the research, it was determined that the minimum value of the strength reserve coefficient is equal to 166, and it was concluded that this shaft fully meets the specified requirement for the device.

Introduction. In the technological processes of many cotton-ginning enterprises in the world, one of the main tasks is to clean cotton raw materials from various scalping, impurities based on highly efficient technological processes and at the same time preserve its natural properties. In the United States of America, Australia, China, India, and some Central Asian countries, special attention is being paid to the creation of efficient technologies for the cleaning of cotton raw materials, to increase the amount and efficiency of cotton fiber production, to create resource-saving technologies, to modernize technological processes, and to increase the competitiveness of the fiber. Many researchers are engaged in the cleaning of cotton raw materials from foreign impurities, the introduction of various innovative developments in technological processes, the application of technology and systems for mechanical and air cleaning of small and large impurities. One of the important tasks is to create an intensive automated system for cleaning cotton raw materials from various scalping, develop new methods and directions of cleaning technology, including increasing the number of cleanings in order to increase the cleaning efficiency of the machine. The analysis of the research conducted in this direction to solve the mentioned tasks confirms the relevance of the topic of this article.

Today, the increase of the amount of cotton pieces in the waste, which is separated from the technological equipment for cleaning cotton from large impurities in cotton ginning enterprises, causes them to disappear with the waste. In order to prevent this problem, 1RX cotton regenerator is installed in enterprises for each cleaning system [1-2].

One of the main disadvantages of existing regenerators in enterprises is the low productivity and cleaning efficiency of separated cotton pieces, and it was observed that waste and pieces of cotton passed between the columns as a result of hitting the columns when entering from the middle pipe of the waste cotton supply with air. Due to the extreme dirtiness of the cotton coming out of the regenerator, if it is mixed to the cotton coming to the cleaning system, the negative effect on the overall quality indicators of the received fiber will increase [3]. It is necessary to strengthen the cleaning of separated cottons in the regenerator, taking into account the need to bring the level of contamination to the same state in order to add the piece of cotton separated from the regenerator to the cotton in the flow.

Brushes are replaced several times in a season due to wear of the brushes of the separating brush drums of the 1RX cotton regenerator. In addition, wear varies between brushes, causing the brushes to become less efficient at removing cotton from sawing drum saws. Therefore, using a drum with a rubber plate instead of a brush drum to separate the cotton from the saw teeth is considered a solution to the problem of constantly changing the brushes. The separating drum of the 2RX-M cotton regenerator, developed by the "Pakhtasanoat Scientific Center" JSC, was made with a rubber plate, and this drum regenerator was introduced to the "Baghdod" cotton ginning enterprise in 2019 and has been used without repair until today. It was recommended to replace the separating brush drums of 1RX cotton regenerators with rubber-plate drums [4, 5]. Based on these recommendations, some changes were made to the construction of the unit to increase the efficiency of cleaning and separation of 1RX type cotton regenerators, which are used in cotton ginning enterprises. It was observed that the 1RX regenerator was fed from both ends of the waste cotton sawdust drum, and air was drawn from the middle, resulting in a reduction of cotton pieces in the waste. In this case, when the waste cotton is divided into two parts during its movement in the air duct, it is easier to

clean it by dividing it into small pieces towards the saw drum. Our next change is that the slats of the drum with the separator plate are installed at an oblique angle along the axis to the center of the drum, so that the cotton is removed from the saw tooth and directed towards the center and then relearning takes place. In order to reduce the amount of cotton pieces from the regeneration drum to the waste, the distance between the columns of the lower column grid is reduced [6].

In addition, it is necessary to determine the strength of the newly installed plate drum in order to improve the design of the regenerator and carry out experiments on it. The body providing this stability is considered to be the drum shaft, and in this work, the strength of this shaft was checked using a special program.

Calculation of cotton regenerator slatted drum shaft.

The slatted drum shaft in the improved RX regenerator is subjected to external loads due to high speeds. Inadequate strength and uniformity of plank drum details, as well as vibrations can lead to deterioration of the process of separating cotton from the saw drum, deterioration of cotton quality, and premature failure of the details without uniform bending. Therefore, it is very important to perform strength calculations of the drum shaft, plates, drum shell, flange (disc) and other parts [7-8].

Fig. 1 shows the planar drum shaft and the calculation scheme of the loads acting on it. External loads affecting the shaft include:

- Evenly distributed load acting on the shaft between the supports (we do not take into account the effect of the weight of the separated cotton, due to its smallness)

$$q_1 = \frac{G_{вал} + G_{гар} + G_{коб} + G_{пл.}}{l_0} \tag{1},$$

here:

$G_{вал}$ – shaft weight between supports, kg;

$G_{гар}$ – weight of flanges, kg;

$G_{коб}$ – weight of shells, kg;

$G_{пл}$ – plank weight, kg;

- evenly distributed load on the cantilever part of the shaft q_2;
- pulley mass $G_{шк}$;
- torque of the electric motor $M_{бур}$
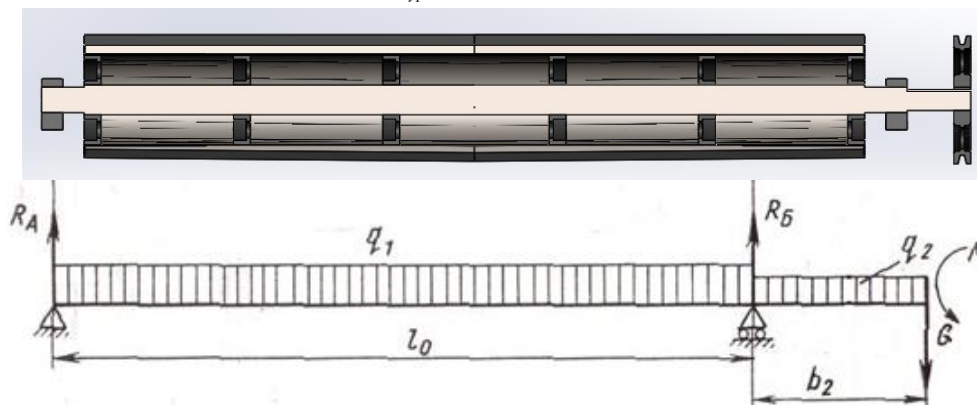
Figure 1. Calculation scheme of the loads acting on the shaft of the slatted drum

Torque acting on the slatted drum shaft $M_{\textit{бур}}$

$$M_{\textit{бур}} = 9550 \cdot \frac{N}{n} \qquad Nyuton \cdot m \,,$$

where: N – power transmitted to the flat drum ($N = 3{,}0\ kVt$);

n – Rotational speed of the slatted drum ($n = 1000\ ayl/\min$).

$$M_{\textit{бур}} = 9550 \cdot \frac{3{,}0}{1000} = 28{,}65 \quad Nyuton \cdot m \,.$$

We use the Simulation package of the SolidWorks program for the calculation. For this purpose, the slatted drum was drawn separately in 3D according to the detailed dimensions, the material was selected and the assembly was made.
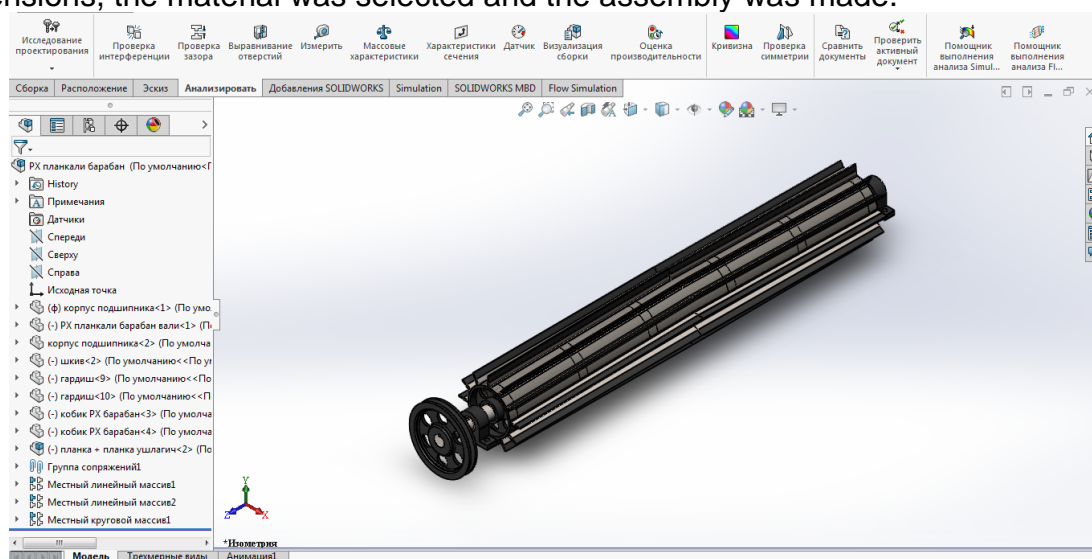
To find $q_1\ q_2$, $G_{\textit{шк}}$, we determined the mass of the details using the SolidWorks Analysis function, and found the mass using Mass characteristic.

That is, $G_{вал} = 61{,}09$ kg; $G_{гар} = 3{,}57 \times 6 = 21{,}42$ kg; $G_{коб} = 4{,}79 \times 2 = 9{,}58$ kg; $G_{пл} = 2{,}59 \times 12 = 31{,}08$ кг; $G_{шк} = 9{,}82$ кг; $q_2 = 2{,}21$ кг.*

We put the obtained values in equation (1).

$q_1 = 61{,}09 + 21{,}42 + 9{,}58 + 31{,}08 = 123{,}17$ кг.*

Note: the program itself calculates the equalty of distribution of weight to length.

All the data for the static calculation of the slatted drum shaft are ready. To simplify the calculation, we use q_1 instead of the shaft between the supports, flanges, shells, plank, q_2 instead of the pulley base of the shaft, and $G_{шк}$ instead of the pulley.

We select the working part of the shaft and select $q_1 = 123{,}17$ kg, the part of the pulley base of the shaft and we select $q_2 = 5{,}45$ kg, the part of the pulley base of the shaft and we select $G_{шк} = 9{,}82$ kg, the part of the pulley base of the shaft, and the torque we insert $M_{бур} = 28{,}65 \ N \cdot m$. (2 picture).

To make the calculation more accurate, we also take into account the centrifugal force and write 1000 rpm (Figure 2).
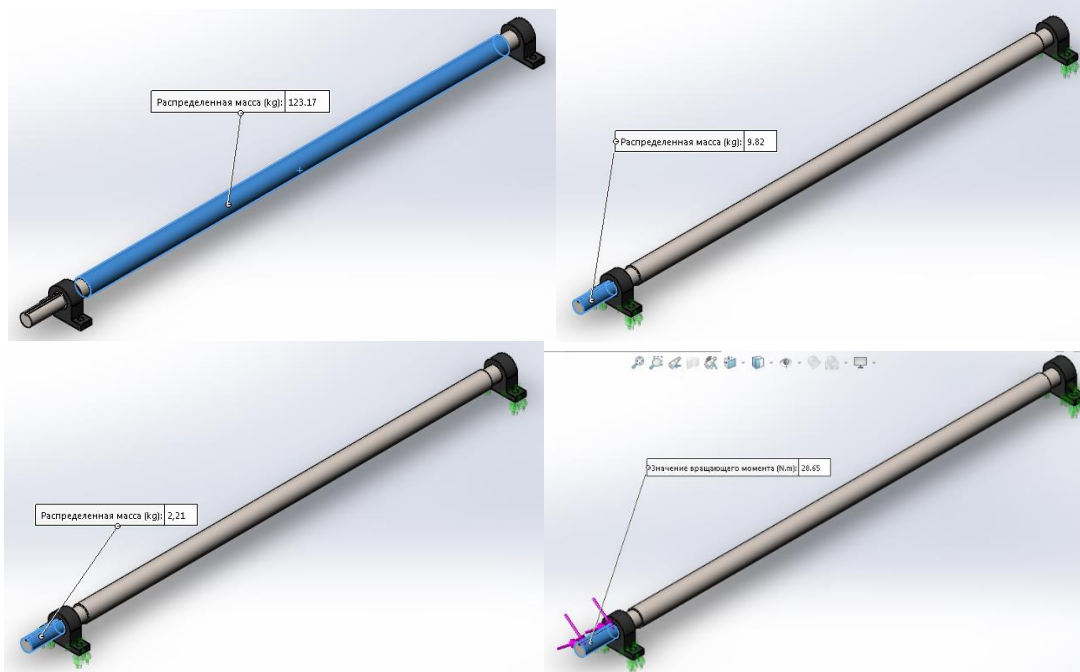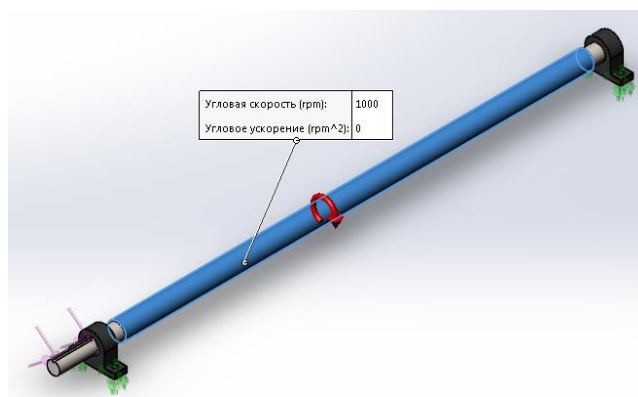
Figure 3 shows the obtained curves. So, the greatest stress in our shaft was ≈3.69 MPa and it occurred in the place painted in red (Fig. 3, a), the greatest displacement occurs in the cantilever part of the shaft and was 0.0081 mm (Fig. 3, b Fig.), the equivalent deformation of the shaft was 0.0000135 (Fig. 3, c) and the strength reserve factor was 166.
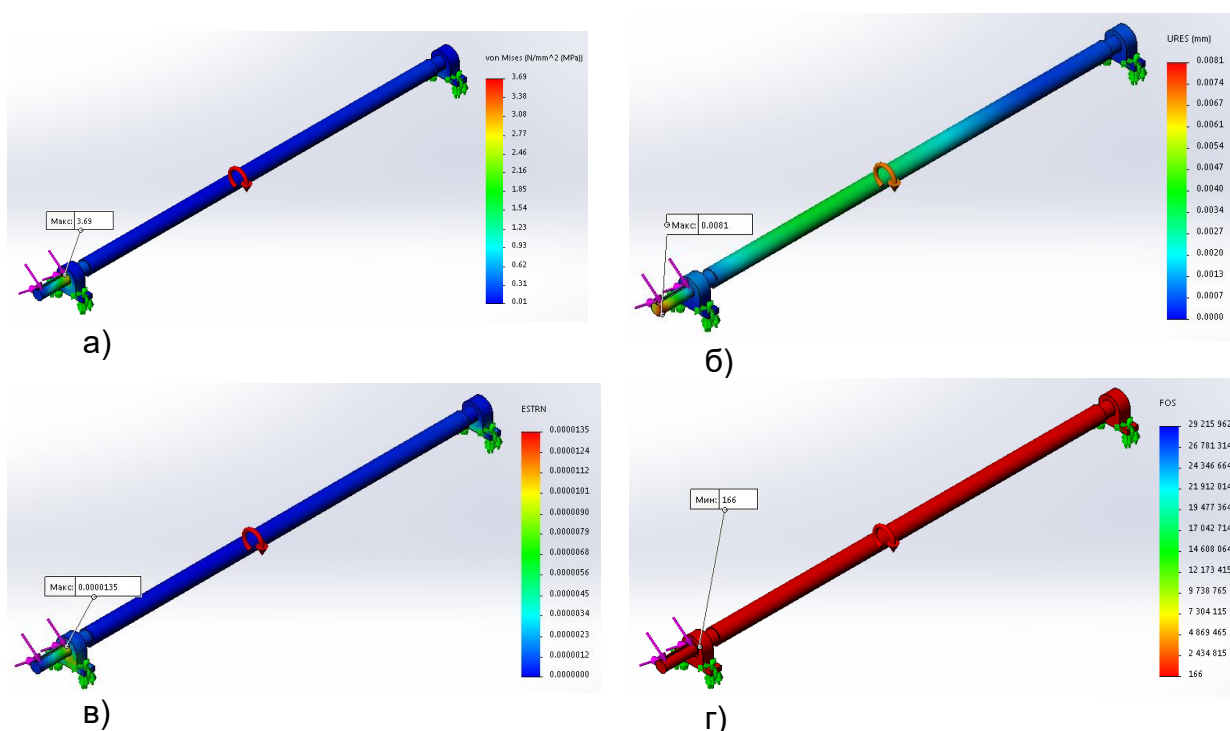
Figure 3. Plank drum shaft epuratures

Concussion. As can be seen from Figure 3, the minimum value of the strength reserve factor is 166. For shafts, this coefficient should be $[k] \geq 1{,}5 \div 2{,}5$. So our shaft meets the demand.

References

1. R.K. Djamolov, U.M. Ismailov. Improving the efficiency of cotton regeneration technological equipment. Proceedings of the international scientific-practical conference "Modern innovative technologies in light industry: problems and solutions", Bukhara Institute of Engineering and Technology, Bukhara-November 19-20, 2021, p. 391-396.

2. A.A. Obidov M.M. Sultanov. To research the method of separating fibers suitable for spinning on a needle drum. International scientific and practical conference Cutting Edge-Science. June 29-30, 2020 Shawnee, USA, 128-131 P.

3. Patent FAP 00335 RUz "Drum for removing raw cotton from saw cylinders and transporting it in cleaners".

4. Avazbek Azamatovich Obidov and Mirzaolim Mirzarakhmatovich Sultanov. Study of Technological Parameters of Fiber Separation Device. International Journal of Psychosocial Rehabilitation. 2020, Volume 24 - Issue 5, 6400-6407 P.

5. Borodin, P.N. report, on topic 9807, JSC SPC "Paxtasanoatilm", Tashkent, 1999.

6. G.I. Miroshnichenko. Fundamentals of designing machines for the primary processing of cotton. M., "Engineering", 1972. 486 p.

7 Under the general editing of A.I. Makarova. Fundamentals of designing textile machines. M., "Engineering", 1976. 416 p.

8. A.A. Umarov, D.M. Kurbanov. Methodical guide for practical training in "Engineering analysis in the cotton industry". Namangan, 2021. 144 p.

ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

METHODOLOGICAL ISSUES OF ORGANIZING INTERNAL AUDITS AND CONTROL OF OFF-BUDGET FUNDS IN HIGHER EDUCATION INSTITUTIONS

KHOJAEV AZIZKHON

Associate professor of Fergana Polytechnic Institute
E-mail: a.xojayev@ferpi.uz, phone.: (+99890) 274-33-99

Abstract:

Objective. The article describes the issues of improving the income and accounting of extra-budgetary activities in higher education institutions. Study of non-budgetary activities in higher education institutions and determination of ways to improve their accounting.

Methods. Statistical methods such as systematic approach, comparative analysis, statistical analysis, and comparison are widely used in the research.

Results. In the study, the directions of income-generating activities of higher education institutions, their consumers, the resources necessary for the implementation of these activities, and other activities in the organizational structure of the university were studied in detail. New analytical accounts of accounting were recommended for the improvement of processes related to them.

Conclusion. The structural structure of the income-generating activities of higher education institutions was studied for their off-budget activities. Also, based on analytical accounts recommended on the basis of the results of the research, it is possible to objectively determine the income received from each of the extra-budgetary activities of higher education institutions.

Keywords: budget organization, higher education institution, funding sources, extra-budgetary funds, income and expenditure estimates, control, internal audit, financial control, state financial control, staff table

Introduction. Today, one of the main issues is taking into account the correct Organization of accounting for income and expenses in state higher education institutions. Because recently, in the information provided by the Ministry of Higher Education, Science and innovation, 49 out of 69 State Higher Education Institutions ended their activities with profit and the remaining 20 with a loss [1].

Accordingly, it can be said that one of the important issues is to study the activities of state higher education institutions, the implementation of estimates of their incomes and expenses, and the proper organization of extra-budgetary funds. Because now, state higher education institutions are financed from the state budget, on average, 25-30 per cent, and the rest is financed from extra-budgetary funds.

It can be seen that studying the nature, types and accounting of non-budgetary funds from state higher education institutions is considered one of the important issues, which determines the relevance of the selected research topic.

Literature revives. In the structure of revenues of extra-budgetary funds of budgetary organizations, the issues of formation of revenues of the development fund of budgetary organizations, formation of revenues of material incentives and development funds of medical organizations, formation of revenues of extra-budgetary funds of ministries, state committees and agencies, formation of extra-budgetary funds of budgetary organizations at the expense of collected payments are covered by the Code [2].

The guidelines on the organization of accounting in budget organizations have been approved, which include theoretical and practical issues of the organization of accounting [3].

A.K. Ibragimov and B.B. Sugirbaev's research paper studied the theoretical and practical issues of budget control and audit

organization [4]. In M. Ostanakulov's research, the issues of accounting organization in budget organizations were investigated [5]. In the research of S.U. Mehmonov, the issues of improving accounting and internal audit methodology in budget organizations were studied [6]. M.Kh.Saidov studies higher educational institutions.
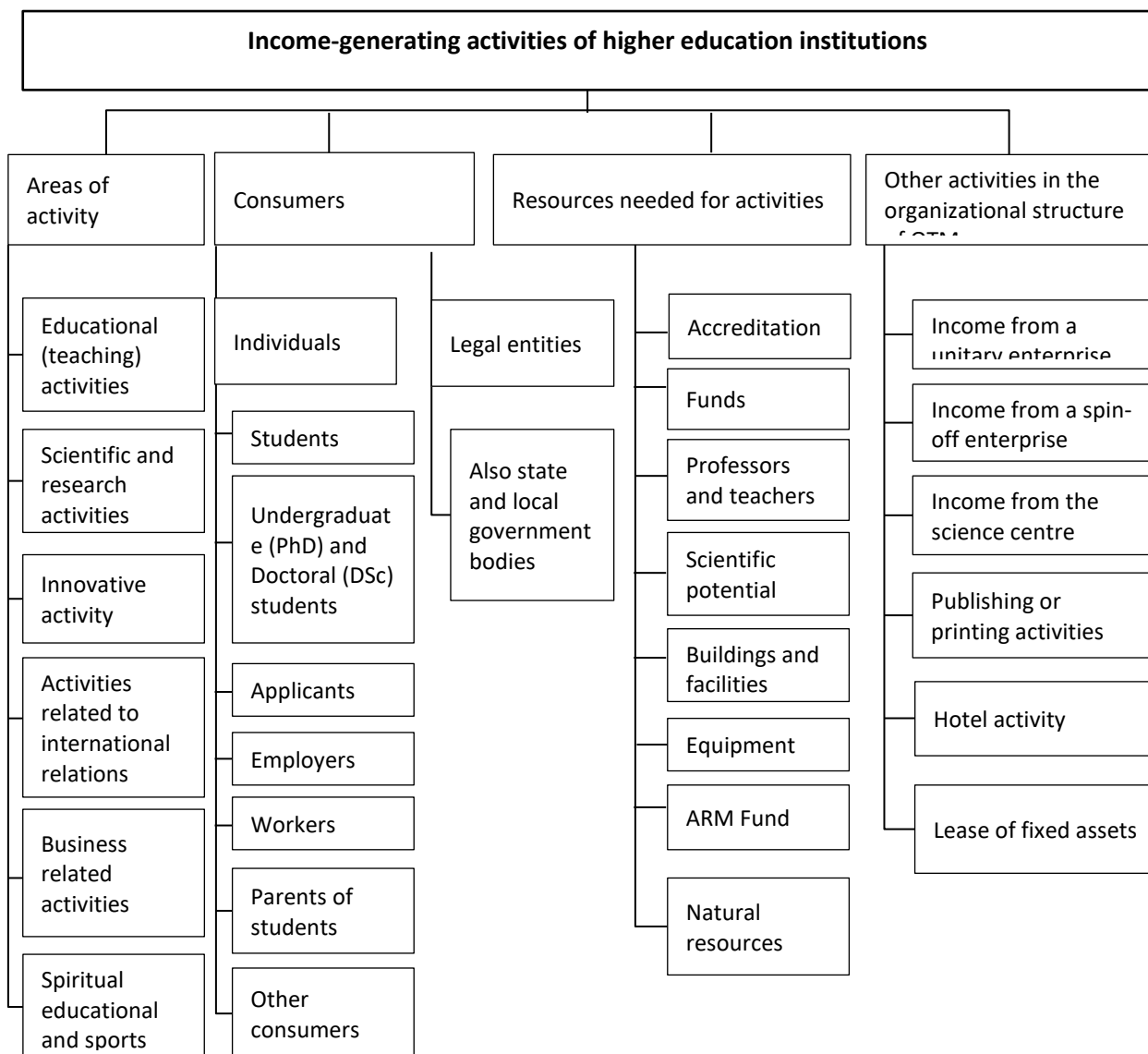
Figure 1. Structural structure of income-generating activities of higher education institutions [9]

Methods. Statistical methods such as systematic approach, comparative analysis, statistical analysis, and comparison are widely used in research based on the theoretical and practical importance of scientific work.

Results and discussion. Today, in the financing of state higher education institutions, special attention is paid to the issues of accounting for the state budget as well as non-budgetary funds. Therefore, it is necessary to know the extra-budgetary activities of higher education institutions and their types of income.

In general, the areas of activity that bring income to higher education

institutions can be seen in the following picture (Figure 1).

Higher education institutions can be divided into the following groups according to the areas of income-generating activity:

1. Earnings from the main activity:

−teaching students, including foreign students

−training of basic doctoral students (PhD) and doctoral students (DSc);

−providing in-depth education;

−training in additional subjects for admission to universities;

−training in retraining and professional development courses for professors and teachers;

−additional paid education, including organization of circles, sections, and clubs;

−training in specially created conditions;

−other educational services.

2. Income from scientific and research activities:

−sale of scientific (scientific-technical) developments, objects of intellectual property;

−provision of services related to scientific research: consulting, expertise, patent work, etc.;

−execution of business contracts and state grants based on scientific research works;

−income from publishing scientific journals, and holding scientific conferences and seminars.

3. Income from innovative activities:

−income from the introduction of innovations;

−income from the introduction of new scientific developments created by professors and teachers.

4. Income from activities related to international relations:

−Training of students based on joint educational programs;

−Involvement of international students in educational exchange programs;

−Conducting international conferences and seminars;

−Attracting international grants.

5. Income from business activities:

−Income from renting buildings;

−Deposit funds;

−Purchase and sale of shares and other securities of other companies;

−Student accommodation fees;

−Providing hotel services;

−Proceeds from financial sanctions (fines, fines, etc.).

6. Income from spiritual educational and sports activities

−conducting social and spiritual events;

−organization of short-term courses on improving the social and financial literacy of the population;

−earning income by renting out the university's sports facilities or attracting additional users to clubs.

Also, today, income is received from students' basic, increased or differentiated payment contract funds, payments made to universities for the re-acquisition of credit debts of students from subjects they failed to master under the credit-module system. But since all of them are reflected in one account, it is not possible to get transparent information about each of them. Accordingly, to improve the activities of state higher education institutions, it is recommended to obtain the following analytical accounts:

− the following accounts are recommended to improve the analytical calculations for the base calculation amount, and increased and classified part of the payment contract funds:

"343610 (175/1) - Funds received from the amount of the basic payment contract";

Analytical accounts "343620 (175/2) - Funds from increased and differentiated payment contract amount" are recommended. With the help of these recommended analytical accounts, the payment of the basic, increased and differentiated part increases the ability to obtain accurate information on the fulfilment of contractual obligations and make relevant financial decisions.

– It was recommended to open a new analytical account called "343630 (175/3)-Debt payments from subjects according to the credit module system" and keep the related calculations in this account in connection with the payments made for the re-acquisition of credit debts of the students under the credit-module system. This makes it possible to obtain information on credit debt in higher education institutions under the credit-module system.

– In order to account for the payment funds received from students in student accommodation, it was recommended to open a new analytical account "343650 (175/5)-Student accommodation fees" and to maintain it. It is possible to receive information on the funds of the payment made through this.

Through the introduction of the above analytical accounts, it is possible to transparently determine the final financial results of the educational institution by calculating the income and expenses received from the higher education institutions in the areas of activity.

Conclusion. The following conclusions were drawn based on the research conducted on the improvement of the calculation of income and expenses in the extra-budgetary activities of higher education institutions:

1. In order to find additional extra-budgetary funds for the activities of the higher education institution, it is necessary to take into account the existing material and technical base, scientific potential and the capabilities of professors and teachers.

2. The structural structure of the revenue-generating activities of the state higher education institutions in terms of extra-budgetary activities was clarified and the structure of their possible income was studied.

3. In addition, separate analytical accounts for the base calculation amount, the increased and classified part of the payment contract funds in higher education institutions today were recommended:

"343610 (175/1) - Funds received from the amount of the basic payment contract";

Analytical accounts "343620 (175/2) - Funds from increased and differentiated payment contract amount" are recommended. With the help of these recommended analytical accounts, payment of the basic, increased and differentiated part of higher education institutions will increase the ability to receive accurate information on the fulfilment of contractual obligations and make relevant financial decisions.

4. To open a new analytical account called "343630 (175/3)-Debt payments from subjects under the credit module system" regarding the payments made by students for re-acquisition of credit debt from subjects they failed to master under the credit-module system introduced in universities and the calculations related to them it was recommended to keep in this account. This makes it possible to obtain information on credit debt in higher education institutions under the credit-module system.

5. In order to account for the payment funds received from students in student accommodation, it was recommended to open a new analytical account "343650 (175/5)-Student accommodation fees" and to maintain it. It is possible to receive information on the funds of the payment made through this.

The above directions of activity recommended to higher education institutions, the recommendation to consider extra-budgetary funds through the

inclusion of analytical accounts, provides the opportunity to determine the final financial results of the specific activity of the educational institution by calculating the income and expenses received from the higher education institutions according to the activities.

Reference:

1. Based on the information of the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan.https://edu.uz/media/53f956aa-be00-124a-3f8f-90a6fbdc8bdf.pdf

2. Code. "Budget Code of the Republic of Uzbekistan". 2013.

3. Order. "On approval of the guidelines on accounting in budget organizations", Order No. 105 of the Ministry of Finance of the Republic of Uzbekistan, December 17, 2010.

4. A.K. Ibragimov, B.B. Sugirbaev. Budget control and audit. Study guide. infoCOM.uz LLC. T.: 2010, 192 p.

5. M. Ostonakulov. "Accounting in budget organizations". Second edition.-T.: Economy-finance, 2009. 428 p.

6. S.U. Mehmonov. "Improvement of accounting and internal audit methodology in budget organizations". A doctor of science (DSc) is written to obtain a degree. dis.avtoref.-T.: 2018. B36.

7. M.Kh. Saidov. "Financial management in the higher education system: Study guide". T.: Boston of Thought, 2011. 432 p.

8. Sh.V. G'aniev. "Improvement of accounting and financial control in budget organizations (as an example of the educational system)", written for the degree of PhD in EconSc. dis. abstract. T.: 2008.

9. Prepared based on the author's research.

THEORETICAL FOUNDATIONS OF ESTABLISHING NEW TECHNOLOGIES ON PERSONAL MANAGEMENT SYSTEM

NOSIROV ILKHOM

Professor of Fergana Polytechnic Institute
E-mail: nosirovilomzon@gmail.com, phone: (+99894) 398-47-44

Abstract:

Objective. It consists in the development of scientific and practical recommendations and proposals for improving team management processes in the service sector.

Methods. This article uses the methods of scientific observation, abstract-logical thinking, conversation, statistical, economic, financial, and expert assessment. The reliability of the information base used in this article is explained by the fact that they are obtained from official sources, and the reliability of the developed proposals and recommendations is explained by the level of compliance with the priority directions and programs of the development of our republic. Relevant conclusions in the field have been adopted into practice by official organizations.

Results. The scientific significance of the research results is explained by the fact that the theoretical-methodological and methodological apparatus for the further development of the improvement of team management processes in industry, service and other fields has been formed from the developed scientific-practical proposals. The conclusions and theoretical knowledge obtained on the improvement of team management processes in the service sector can be used as a scientific resource in the Ministry of Higher and Secondary Special Education of the Republic of Uzbekistan and other enterprises in the service sector.

Conclusions. Team management in the service sector reaches a high level of improvement of skills, and as a result of active activities and special training, its increase occurs. The worker is interested

in imparting his knowledge to the youth. This period is characterized by self-sacrifice from the creative side, in which it is possible to rise to new levels of service.

Keywords: Human resources, management, personnel, innovation, employees, skills, economic sectors.

Introduction. In the leading sectors of the economy of the countries of the world, in particular, in industry, great attention is paid to the issues of following modern management principles in the processes related to team management. As a result, effective organization of the management structure of the team in the economic sectors of most countries of the world remains one of the most important tasks today. Scientific research including introducing modern corporate management methods in the management of companies, establishing effective forms of corporate relations in them, developing innovative models of team management, formation of management relations as a system covering social and spiritual aspects, mental abilities and values of a person, directions for motivating team work in the enterprise and strengthening management principles aimed at increasing the effectiveness of the use of an effective method of managing the enterprise team remains the main current issues in the world.

In modern literature, especially in the management of teams in enterprises, the attitude to the object of research is expressed in different ways. Perhaps this is suitable for the modern age. In our opinion, the principles and methods used can be effective only with a clear idea of the object of the management process. For example, nowadays in literature and practice, "Human resources", "Labor resources", "Personnel", "Employees", "Team representatives", "Experts" and other phrases are widely used. In order to clarify, we expressed our opinion graphically. (See Figure 1).
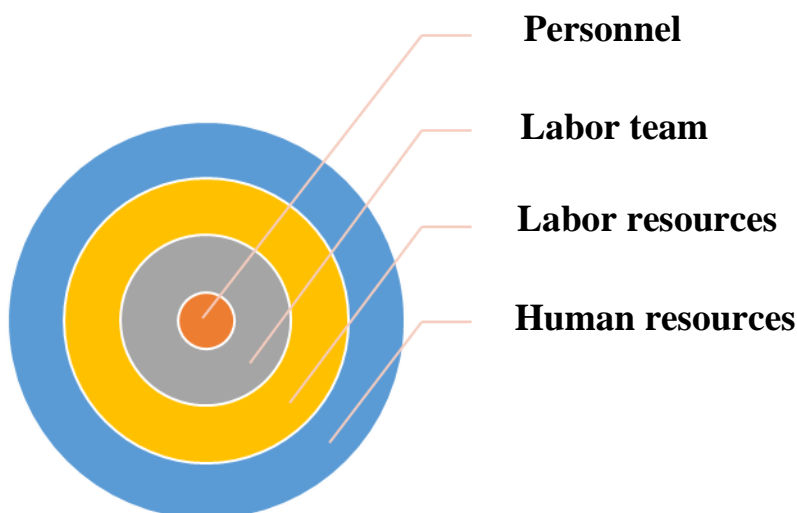
Figure 1. Management of Human factor and labor team

As can be seen from the figure, management objects are divided into four groups, and the main, comprehensive group is human resources management. This object is mainly a macroeconomic indicator and plays an important role in solving problems between the world and countries (growth of human resources, population composition, their social protection, development, etc). Human resources include all human resources in the world and countries, and it has its own management tasks. Labor resources are mainly limited to the circle of people who

have the ability to work. Of course, this indicator may have different limits in many countries. For example, in the Republic of Uzbekistan, the population with labor resources from the age of 18 to the retirement age (men up to 60 years, women up to 54 years) is considered to be able to work.

Methods. Scientific research, abstract-logical thinking, interview, statistical, economic, economic, expert methods are used to check the scientific and practical importance of research. The reliability of the information base produced in this article is that they are taken from official sources, and the reliability of the proposals and recommendations is the development of the priority directions and programs of our republic. Sohagaoid is accepted into the official practice of the relevant approved.

Employees are those who are actually working, or in other words, the part of the labor resources recorded in the organizational list of organizations. When we say "organization", we mean enterprises operating from private entrepreneurship to large state enterprises.

Taking into account the national characteristics, the scientific-theoretical and methodological foundations of team management processes in Uzbekistan's economic sectors, in particular, in the field of direct service, were developed by B.Khodiev, S.Gulomov, N.Yuldoshev, A.Bekmuradov, M.Ikramov, SH. It is widely covered in the works of Zaynutdinov, M.Mahkamova, R.Nurimbetov, SH.Mirsaidova, Y.Goldman.

Directly in our republic, there are still no well-founded and clearly developed methods for evaluating personnel management processes in the industry, service sector, there is a need to research the structure and socio-economic essence of personnel management processes in the service sector, to develop methods of team management processes in industry enterprises. Methods of evaluation and management of innovative potential of enterprises are insufficiently researched as an independent research object.

In this article, as theoretical and methodological bases, relevant laws of the Republic of Uzbekistan on the field, decrees, decisions and works of the President of the Republic of Uzbekistan, decisions of the Cabinet of Ministers, fundamental works related to the further increase of the innovative potential in the industry and service sector in our country, innovative works of national and foreign scientists of industrial enterprises the works written on the improvement of management methods and assessment of potential served.

Results and Discussion. Employees include all labor resources in the organization according to the traditional distribution, including personnel and others. The labor team is a group of working people of the organization and is divided into specific groups (managers, workers, service providers, students, etc). Personnel is an employee with a certain specialty, potential and ability. In our opinion, every employee cannot be called a Staff, because it is related to the way of working, knowledge, and intelligence. Personnel management (human resource management) is a set of activities for selection, training, organizing the activities of the organization's employees, wages and other social and spiritual activities. The master Amir Temur wrote in his books that "I have seen in my experience that one person who is business-minded, has courage and enthusiasm, is determined, entrepreneurial and alert, is better than thousands of inactive and indifferent people, because one experienced person gives work to a thousand people."[1] Selection of employees and their rational management is one of the most responsible tasks in the activity of any organization. Several issues related to the

---

[1] **Amir Temur. «Institutes of Temur»,** p..**25** .

theory of personnel management (principles of work, inclination to it, new methods of management, identification of the need for personnel, their selection, recruitment, work with them, training, business career and training of reserve personnel, conflicts and their management) were considered in our previous book. In this book, we decided to consider other issues related to the theory of personnel management. McKay, the author of the recruitment method, noted, "I have never seen a person with a bad reference letter."

Such papers will remain as papers. Every leader must be a psychologist. When hiring in Japan, first of all, a person's knowledge is considered. The information presented in the personal statement is thoroughly studied. Good work experience and special expertise are required to work as a senior manager in American and European countries. Enterprises and organizations have different approaches to managing their employees. Table 1. compares some indicators of the Japanese and American approaches in this direction.

Table 1.

American and Japanese approach to managing employees of enterprises and organizations

№	Criteria for working in the organization	Japanese approach	American approach
1	The basis of organization	Matching	Efficiency
2	Attitude to work	The main thing is to fulfill the obligation	The main thing is to fulfill the obligation
3	Rivalry	Not in practice	Strong
4	Guarantee for the employee	High (lifetime hire)	Low
5	Decision making	Bottom up	Top down
6	Delegation of authority	Kam holatda	Keng tarqalgan
7	Dealing with subordinates	Family	Official
8	Recruitment method	After graduation	By work qualities
9	Paying for labor	Based on work experience	By work results

Recruiting good employees for any organization is a complex and multi-step process. It includes scientifically based principles and methods of operation. Below we consider the main issues of personnel management services that deal with this problem. This involves several steps:

1. **Personnel planning**. It consists in determining the demand for human resources, considering the future development of the organization. Of course, when creating such a strategic plan, it is necessary to take into account the changes that will happen with the employees who are currently working. These changes may include::

−promotion of employees;

−leave for work; to be sent to other enterprises for study and business trip;

−retirement and other factors. In other words, it will be necessary to draw up a strategic plan of personnel management. In addition to the above factors, it is necessary to take into account the use of internal resources and the traditions of the organization.

2. **Dispatch of team members**. Searching for and attracting potential employees from among specialists, creating a personnel reserve is a permanent main task. For this purpose, it is advisable to use various information systems and communication tools widely. This is a large and complex service that

requires constant attention and deep knowledge.

3. **Selection of employees for the team**. Evaluating candidates for vacancies taking into account specialization, business and human characteristics is a very complicated issue. It works well to involve supervisors in the evaluation of such candidates, especially supervisors in the area where the recruitment is intended. Selection and confirmation of the reserve personnel created by the team management colleagues gives a good result.

4. **Determination of monthly salary and benefits**. It is fair to set wages and benefits based on the performance and contribution of each employee. It is desirable to develop and use an objective and flexible system.

5. **Skill building**. It includes the fact that the hired employees are engaged in the effective operation of the organization, diligently fulfill the tasks that the employee must perform, and others. The further improvement of the psychological environment in the team, the creation of comfortable conditions in the workplace and production environment are of great importance for the formation of skills in employees.

6. **Team training**. Training of qualified specialists, development of new programs, as well as their effective use, periodic retraining of employees in order to increase and develop professional knowledge in the team is considered necessary. This process involves several issues:

a) studying new proposed manufacturing processes;

b) learning foreign languages;

First direction:

a) social protection of the team employee (constant health care, ensuring timely rest, improvement of living conditions and organization of reasonable nutrition);

v) having advanced production experiences in our republic and abroad;

g) internship in advanced enterprises of the republic and abroad;

d) providing and getting acquainted with new literature on the specialty.

7. **Management of the employee's professional growth**. It is necessary to create such conditions that each employee can satisfy his interests and requirements while bringing great benefits to the organization he works for.

8. **Personnel certification**. To develop a method of objective assessment of the work results of each specialist in quantitative and qualitative indicators, to determine the level of his specialization. It is necessary to involve the leading employees of the duty service and departments in this work, and to familiarize the employee with the attestation documents and results in a timely manner.

9. **Placement of employees**. Based on the results of the attestation, solving the issue of redeployment of employees according to the staff list (upgrading the position ladder, leaving in place, downgrading, transferring from one workplace to another workplace and dismissal).

10. Training of management personnel. Improving the leadership skills and level of senior staff includes the problems of program development, experience of working with employees and their concentration, as well as creating a pool of personnel among young employees.

Issues in the team's personnel management service include organizing work with employees in two directions. These directions include as follows:

b) advanced team employee reward programs (awards, labels, referrals, titles, orders, etc.);

v) development of instructions and suggestions to the manager on improving working conditions, ensuring the creation of

a creative psychological environment in the team.

Second direction — law and disciplinary direction - covers a wide range of issues of interaction between the team and management (labor relations, disputes, conflicts, instructions for managers and employees, bilateral contracts, applications of various contents, etc.)

Being a team leader is very difficult. Therefore, their thoughts, outlook, spirituality, character, and mentality are also different. Of course, the leader will have to keep an eye on their various good and bad works, so that no work is left out of their sight. If a leader is only busy with management and his personality, and is indifferent to monitoring the people under his command, then this leader should be abandoned. Not being aware of the behavior of the members of their institution leads to the division of the team into several parties. Such a leader will harm both the state and the community.

Conclusions. Team management in the service sector reaches a high level of improvement of skills, and as a result of active activities and special training, its increase occurs. The worker is interested in imparting his knowledge to the youth. This period is characterized by self-sacrifice from the creative side, in which it is possible to rise to new levels of service.

- A person achieves his independence and the highest peak of self-expression. Respect for oneself, respect for others who have achieved their position through honest work, respect for oneself and others will increase. Although most of the employee's requirements have been met by this time, he is interested in the level of wages, and interest in income from other sources increases.

- The final stage lasts from 60 to 65 years. The employee begins to prepare for retirement. During this period, finding a reliable successor and training the candidate for the vacating position will increase. Although this period is characterized by a career crisis (the employee begins to feel discomfort from a mental and physical point of view, getting less satisfaction from work). Self-expression and respect for self and others are elevated to a higher level. The employee is interested in maintaining the level of salary while trying to increase income from other sources, which will provide a good supplement to the pension income as salary replacement funds before retirement.

- At the next benefit stage, the job level (type of activity) in this enterprise is completed. There are opportunities for self-expression in other types of activities, which were realized only as a hobby of interest without being realized while working at the enterprise (painting, gardening, working in public enterprises, animal husbandry, etc.).

- Respect for oneself and respect for retired people increases. However, financial ethics and health dictates the need for income from other sources and ongoing health care.

- Career management requires a full understanding of what happens in people and a study of the various career stages. Special research is conducted for these purposes, and includes enterprises interested in effective career management.

- Some of the research results are formalized in a special form called careerogram, and clearly represent the manager's path through the career ladder.

- Every person plans his future based on his requirements and taking into account the socio-economic conditions that have arisen. It is no surprise that he wants to have clear information about his future career growth and development opportunities in this company, as well as what he will do to achieve this.

References

1. Mirziyoyev Sh.M. We will build our great future together with our brave and noble people. -Tashkent: Uzbekistan, 2017. P.488

2. Mirziyoyev SH.M. Ensuring the rule of law and human interests is the guarantee of the country's development and people's well-being. - Tashkent: Uzbekistan, 2017. P.48.

3. Abdullaev O.M., Qosimova M.S. and others. Marketing. Study guide. Academician Ghulomov S.S. under the editorship. T.: TSUE, 2006. p567

4. Akerberg A. Meaning of Relationships in Knowledge-intensive Work Context. Helsingfors, 1998. - P.12,13

5. Barnov V.A., Kharchenko V.L. Strategic management: Proc. allowance, M.: INFRA-M, 2008. p285

6. Bobryshev A.D. Factors affecting the company's activities Electronic resource. BobryshevA.D. cfin.ru [website]. 2012. Access mode: http://www.cfin.ru/anticrisis/methodical_material/consultants/factors.shtml.

7. Vehlen Th. Engineers and the Prise System / Th.Vehlen. N.V., Viking, 1924128. Partnership Russia-Sweden. October 2001. P. 13-15.

8. Verdoorn J.P. On the Factors Determining the Growth of Labor Productivity. - Oxford: Oxford University Press. 1949.

9. Gulyamov S.S., Ochilov N., Saidakhmedov O. Intellectual economy efficiency factors. Economic newsletter of Uzbekistan. T.: 2015. № 6. P.38-41.

10. I.A. Nosirov. The global environmental problems. Environmental management tasks for their solution. SeyboldReportISSN, 2022., p.p.1533-9211.

11. I.A. Nosirov. Важность управление рисками предприятий в условиях рыночной экономики. Prospects of development of science and education. 2022, p.p. 33-40.

12. I.A. Nosirov. The role of the environmental management of small business development. Theoretical & Applied Science. 2017, p.p.120-123.

13. I.A. Nosirov. The development of youth creativity is the way to exalt creative management. FerGU., Scientific Bulletin. No. 2., 2021., p.p.47-49.

SPECIFIC CHARACTERISTICS OF UZBEK NATIONAL ART OF EMBROIDERY

MAMAKHANOVA ZEBUNISO

Teacher of Namangan Institute of Engineering and Technology

ORMONOVA DURDONA

Student of Namangan Institute of Engineering Technology

Abstract : The article describes the modern development directions of embroidery based on the study of the unique features of the Uzbek national embroidery art. The directions of modern development of embroidery have been determined based on research with students studying design.

Key words: Embroidery, pattern, tools, floral decorations, needle, needle, national values, practical art.

Introduction. Embroidery - needle on fabric or other materials yarn through is a decorative art or craft. The art of embroidery has developed over the

centuries and has been widely used to decorate fabrics. The origins of embroidery date back to the Modern Man period or 30,000 BC. During a recent archaeological survey, fossilized remains of hand-stitched and decorated clothing, boots, and headdresses were found [1].

The art of sewing related to embroidery and many other types of fabric decoration has been proven by the results of many archeological studies. The development of primitive humanity realized that the stitches used to join animal skins could also be used for decoration . Historical monuments, statues, paintings and vases depicted by the population on various ancient objects depict people wearing thread-embroidered clothes.

At the stage of historical development of embroidery, small pearls were widely used to decorate religious items. With that together The business of sewing beads on clothes has also developed went _ By 1500 BC, embroidery was developing in Central Asia as well as in other regions of the world. It is in the Uzbek national embroidery art that in the 1700s, thread and bead embroidery became popular. At the same time as human clothing, embroidery began to be used to decorate home furnishings and many other items.

Uzbek national embroidery is considered one of the most ancient types of folk craft art, and it was formed as a result of the goal of the nation to make its life beautiful. The art of embroidery has been used to decorate national clothes and household items since ancient times.

Today, our national embroidery art is gaining fame not only in our country, but also in foreign countries due to its unique beauty and rich patterns. Uzbek people's hand-embroidered kirkip, sozana, zardevor, flower quilt, bedclothes etc. United States of America, France, Italy, Japan, Germany, Belgium, America, India and Russian Federation is seen as a permanent exponent of high importance in art museums of countries such as

In the sources and miniatures of the XIV-XV centuries, we can find embroidery samples on a large scale. For example, the Spanish ambassador Rui Gonzalez de Clavijo, who lived in the palace of Amir Temur, wrote in his memoirs that he watched the embroidery decorations in the palace. Behzod also depicted an embroidered tent in the miniature "Temur on the Throne" (1467), which he worked on for the "Zafarnama" manuscript.

The diversity of embroidery stitches, embroidery, and styles testifies to the great art of Uzbek embroiderers. For example, in Nurota, Bukhara, Samarkand, embroidery products are sewn with a more wide stitch, in Shahrisabz, with a wide stitch, kandakhayol, Iraqi, and in Tashkent, with a printed stitch. The changes in social life affected the traditions of embroidery and the types of products [2].

In the course of our research, the antiquity of our national embroidery was conducted using the available evidence of archaeological findings and written sources in the territory of the Central Asian countries. Based on the analysis of the historical sources on embroidery, it can be noted that it is through the miniatures of the XIV-XV centuries that we can note the unique development of embroidery. The invention of the embroidery machine in the 19th century led to an increase in the number and variety of new watches in the industry. In addition, it became possible to implement embroidery colors and types of patterns in high symmetrical sizes. Despite this, the tradition of hand-stitching many types of embroidery has been preserved among our people, and a large-scale craft style is developing to this day [3].

Since ancient times, the way of life, culture and rituals of the peoples of Central Asia have been very close to each other. In particular, in Tajik embroidery, beautiful flowers, circular, flower branches , nightingale, circular patterns are used a lot, while in Uzbek embroidery, plant-like, geometric and floral patterns are reflected more. Geometric, plant-like forms, flowers,

birds and fruits are often depicted in Russian embroidery. Kazakh and Kyrgyz embroidery are closer to each other, in which, in addition to flowers, geometric shapes, more animals, horn and hoof-like elements are depicted in different colors.

According to the ancient traditions of the peoples of Central Asia, including the Tajik people, embroidered items were given to Tajik girls as a dowry when they were given in marriage. The bridal dress of the bride is also decorated with beautiful patterns, such as her headscarf, veil, dress, skirt, and even her shoes. In the house of the bride, the bed, the fabric (rojjo) thrown over the blanket, rice, carpet, supra and other household items are decorated with the same pattern as above. The horse and cart carrying the bride to the house where the bride is transferred are also made in the same way [4].

The most amazing thing is that the brides-to-be had to prepare all kinds of embroidery for these dowries themselves. On the day of the wedding, they judged how beautiful the bride was by looking at the things hung in the groom's house. Therefore, girls were taught to embroider from the age of 7-9. After three or four years, they started to embroider independently. Chevar embroiderers tried to express their dreams of beauty according to their art and nature. The finer and more beautiful the embroideries are, the more expensive they are.

Embroidery is one of the ancient branches of applied art. Archeological findings show that embroidery is ancient in almost all nations, and that it has developed under the influence of climate, natural conditions, and the culture, art, and professions of each nation. The appearance of embroidery is connected with the appearance of seams and stitches in leather clothes. During periods, it is connected with the transition from stones, bones, beads, metal beads, weaving, as well as fabric weaving, dyeing and other works [5,6].

Nowadays, the rich and unique artistic wealth and national values of our people, as well as the material and spiritual life of the Uzbek people, have become the basis for the development of modern culture in our country and abroad. The importance of the chosen topic is that in the art of embroidery, which has developed since ancient times in Uzbekistan, we can see in the following pictures that the secrets of the craft have been perfectly mastered and this craft has been raised to the level of art.

The introduction of Islamic culture to Central Asia at the beginning of the 8th century caused the further development of art of decoration and painting. Live creatures in majestic paintings were replaced by images of nature, patterns with plant-like and geometric elements. Arabic writing was assimilated and the decorative (epigraphic) style appeared. In painting, the symbolic philosophical meanings of various shapes, floral elements and colors began to be expressed more widely:

✓ Square - eternity, stability.

✓ The sun is a symbol of life.

✓ Zirk flower (gulsafsar) peace and longevity.

✓ Apple is a symbol of love.

✓ The lion is a symbol of courage, justice and strength.

✓ Humo is a bird that brings happiness.

✓ Green is mother earth.

✓ The color of the air is clear sky.

The above-mentioned forms of embroidery have started to be expressed in various modern forms while maintaining their importance even today. Then, the opinions of design students regarding the reflection of the above-mentioned shapes and colors in modern Uzbek national embroidery were studied by means of a questionnaire. In the survey, the opinions of 212 students studying in the field were studied. According to the results of the survey, it was emphasized that there is a need to express such shapes as the square, Sun, zirk flower, apple, lion and

huma bird as elements of embroidery and that they are important in connecting with our historical traditions.

In the use of colors in embroidery, it was emphasized that along with the results of modern color science, green and orange should be kept as central colors. Samples of works of art named "Our national embroidery in your imagination" by our students are presented in Figure 1.

Figure 1. A sample of our national embroidery

Based on the analysis of embroidery images created by students, it should be noted that while preserving our ancient traditions, it is necessary to pay special attention to modern colors and types of patterns. Formation of embroidery art samples based on today's market economy and marketing requirements is of urgent importance.

In conclusion, it is worth saying that in the art of embroidery, each nation has its own patterns that are used the most, and it is important to develop them based on the requirements of the time. It is necessary for students studying in the field of visual arts to develop their knowledge and skills related to the art of embroidery in accordance with the traditions and values of the Uzbek nation.

References

1. Kamalova SR, Babakhanova Kha.A , Komilova SD . Director of UzTTITI Tashkent branch, kfn "Color engineering" subject set of exposures

2 . NS Gaipova, MA Gafurova, QM Abdullayeva. "Designing, modeling, artistic decoration of sewing products". T.: Creative publishing house named after Cholpon. 2006

3. TAOchilov, NGAbbasova, FLAbdullina, QIAAbdulniyazov. "Gas science" . -T.: Creative publishing house named after Cholpon. 2010 _ _

4. KM Gulomov, SSBulatov Eastern master disciple manners. - UzROO"MTV center for preparation of educational literature, magazines and bulletins, 2000. 120 pages.

5. SSBulatov and M. Ashirov Glossary of applied art terms. - Tashkent: Encyclopedia chief editor, 1991. 86 pages.

6. KM Ghulamov Practical art _ - T: Economy - finance, 2008. 90 pages

UDC 691.327.624.072

ENERGY-SAVING MODES OF THE HEAT TREATMENT OF CONCRETE

RAXIMOV AKMALKHON

Professor of Namangan Engineering and Construction Institute

KHUSAINOV MUKHAMMADALIKHON

Associate Professor of Namangan Engineering and Construction Institute

TURGUNPULATOV MIRZOHID

Teacher of Namangan Engineering and Construction Institute

KHUSAINOV SARVARKHON

Teacher of Namangan Engineering and Construction Institute

GAYBULLAYEV AKRAMKHON

Master student, Namangan Engineering and Construction Institute
E-mail: khusainov1962@gmail.com, phone: (+99894) 305-24-58

Abstract:

Objective. The precast concrete industry is one of the largest consumers of energy among other sectors of the national economy. Heat treatment is an integral and at the same time the longest and most energy-intensive process of precast concrete production. In this regard, based on the determination of optimal steaming modes in a hot climate, it will lead to savings in energy costs, which is the purpose of this study.

Methods. To determine the effect of high outdoor temperature in a hot climate (30....35 ^{0}C) on the process of concrete hardening during heat and moisture treatment during the experiment in the climate chamber, the composition of aggregates and binder material was selected. The composition of concrete on Portland cement is 1:2.69: 4.58, on slag Portland cement 1:2.37 : 4.1. The initial temperature of the concrete mixture was taken equal to 15..20, 20...25 and 25...30 ^{0}C. Cube samples with an edge of 10 cm were tested for compressive strength 4 hours after heat and moisture treatment and after 3 and 28 days.

Results. Research results have shown that the higher the initial temperature of concrete, the greater the strength it gains after heat and moisture treatment. By the end of the heat and moisture treatment, concrete with an increased initial temperature gains a large amount of degree-hours compared to concrete with a lower initial temperature and, accordingly, leads to energy savings during heat treatment, since the strength indicators are 70 and 61% of R28nt.

Conclusion. The assignment of heat and moisture treatment modes for precast concrete products, taking into account the ambient temperature of a hot climate, reduces the time of the active cycle (temperature rise + isothermal heating) for 2...3 hours. The reduction of energy consumption at the same time is 20... 22%.

Keywords – Energy Efficiency, Concrete, Climate, Temperature, Industry, Reinforced Concrete, Technology.

Introduction. The Republic of Uzbekistan has adopted a number of key decrees aimed at improving energy efficiency in the sector of the economy and the social sphere, introducing energy efficient and energy saving technologies, further developing renewable energy, and ensuring the rational use of energy resources.

The precast concrete industry is one of the largest energy consumers among other sectors of the national economy. At present, heat treatment is an integral and at the same time the longest process in the production of precast concrete.

213

Despite some success, heat and moisture treatment has been and remains the longest technological redistribution of precast concrete production, taking 80-90% of the total time required for the manufacture of products.

Currently, over 90% of factory production is subjected to steaming, and more than half of the total volume is produced according to the aggregate flow technology with heat treatment in pit steaming chambers.

The main advantage of steam heating is the ability to provide suitable moisture conditions for concrete hardening, when the steam is in direct contact with the unformulated surface of the products. The widespread use of steam heating in the production of prefabricated reinforced concrete in our country and abroad is explained not so much by the advantages of the method as by its thorough study and great practical experience.

To accelerate the hardening of concrete in prefabricated structures, steam heat treatment has been used since the beginning of the last century.

Numerous studies have being carried out on this issue, and the method is well described in a number of works by S.A. Mironov, L.A. Malinina and B.A. Krylov [1,2,3].

Depending on the accepted manufacturing technology, the conditions for heat treatment of products change: the concrete is heated either through the metal of the mold, or through direct contact of the product with the coolant. In this regard, the question arose about the processing of optimal steaming modes in relation to specific production conditions. Since the mid-50s of the last century, large studies have being carried out on the effect of elevated hardening temperatures on the phase composition, the structure of new formations, the degree binder hydration and the exotherm of cement.

The international conference RILEM, held in 1964 in Moscow, made a great contribution to the problem. There were made a number of reports on the choice of cement for heat treatment [4, 5], the processes of hydration of Portland cement during heat and moisture treatment [6, 7, 8], reduction of concrete hardening time [9, 10, 20], temperature gradients in concrete exposed to steaming [19] hardening of concrete in the conditions of Central Asia [11].

In a hot climate, the high temperature of the outside air (30… .35 ^{0}C) is observed 6…7 months a year. Under such conditions, the temperature of the concrete mixture at the moment of molding reaches 25 ... 30 °C. However, at present, these factors are not taken into account when setting the modes of heat and moisture treatment of concrete, as a result, the duration of heat and moisture treatment and energy consumption at enterprises in the southern and northern regions remain the same.

In order to study the influence of the initial temperature of the concrete mixture and the ambient temperature on the modes of heat and moisture treatment of concrete, we carried out a number of studies.

Methods. Portland cement (R_{ts}=40.8 MPa, S_{sp}=3357 cm^2/g) and slagportland cement (R_{ts}=33.8 MPa, S_{sp}=2593 cm^2/g) were used as binder. The filler was granite crushed stone with a maximum size of 20 mm and quartz sand with M_k=1.88. The composition of concrete on portland cement 1: 2.69: 4.58, on slagportland cement 1: 2.37: 4.1. The experiments were carried out in a climatic chamber. The initial temperature of the concrete mixture was taken equal to 15..20, 20 ... 25 and 25 ... 30 ^{0}C. A concrete mixture with a temperature of 20 ... 30 °C was prepared with heated water. However, after several tests, a slight decrease in concrete temperature was observed during preliminary curing. It turned out that at the time of preparation, only the mortar part of the concrete was heated. The coarse aggregate warmed up slowly, absorbing heat during the pre-holding, causing the temperature to drop. Considering this, in the future, the large

aggregate and the metal mold will heat up to 30 ... 35 °C.

Then the concrete mixture was quickly placed in a mold, compacted by vibration and placed in a climatic chamber. The temperature of the freshly made concrete mixture was measured with a laboratory thermometer and an ETP-M device. Chromel- Copel thermocouples were installed at characteristic points of the sample. The samples were kept for 2 hours at a temperature of 25... 35 °C (depending on the initial temperature of the concrete mixture) and a relative humidity of 45 ... 50%. After preliminary holding, the samples were steamed in the same chamber.

The temperature rise for all series of experiments was 3 hours at an average rate of 20^0C/h, the duration of isothermal heating for concrete on portland cement-2; 4; 6, and on slag portland cement-4; 6; 8 hours. The concrete was cooled for 4 hours at an average rate 10 ^{0}C/h using a ventilator or kept for 6 hours with an open control gate of the ventilation duct. The maximum temperature of isothermal heating of concrete samples on Portland cement-80, on slag Portland cement-90 ^{0}C.

A KSP-4 device was used to measure and record the temperature in the chamber and in the sample sections. The control and regulation of the temperature in the chamber was carried out automatically by the PRTE-2M software controller. In all experiments, the camera load factor was the same. For the reliability of the results, each series of experiments were repeated several times.

Samples - cubes with an edge of 10 cm were tested for compressive in 4 hours after heat and moisture treatment and after 3 and 28 days. For each batch of the same batch, three samples were molded, which were stored in a normal hardening chamber and tested after 28 days.

Results and discussion. The research results showed that the initial temperature of the concrete mixture significantly affects on the increase in strength of concrete prepared on portland cement (table-1).

The higher the initial temperature of concrete, the greater the strength it gains after heat and moisture treatment. However, after 3 days, the strength of concrete with different initial temperatures leveled off, and after 28 days, concrete gained the same strength regardless of the initial temperature (Fig). This, apparently, is explained by the fact that in concrete with a higher strength after heat and moisture treatment, its further growth occurs more slowly than in concrete with a lower strength. This is consistent with the kinetics of cement hydration. In concretes with greater strength, after heat and moisture treatment, a significant part of the cement grains is hydrated, and around the unhydrated core of the grains, denser shells are formed from the products of cement hydration. These shells further, during hardening, impede the penetration of moisture to the unhydrated parts of the cement grains, slowing down the hardening process. Hence it follows that the greater the strength of concrete after heat and moisture treatment, the less its further growth.

Table 1.

Strength of concrete on portland cement under various modes of heat and moisture treatment

Versions	№ Series	Environment parameters in the chamber during preliminary exposure		Initial temperature of concrete mix $T_{c.m.}$, ºC	V/C	Cone draft, sm	Steaming mode, hour	Compressive strength of concrete, MPa through			
		t, ºC	φ, %					4 hours after TBO	3 days	28 days	28 days normal hardening
1	2	3	4	5	6	7	8	9	10	11	12
I	1	15-16	70-75	15	0,65	2-2,5	2+3+6+4	17,4 / 61	20,3 / 71	26,8 / 94	28,5 / 100
	2	20-21	70-75	20	0,65	2-2,5	2+3+6+4	18,6 / 60	22,2 / 72	29,1 / 94	31,1 / 100
II	3	26-28	48-50	22-25	0,65	2-2,5	2+3+6+4	20,5 / 65	22,1 / 70	29,4 / 94	31,4 / 100
	4	26-28	48-50	22-25	0,65	2-2,5	2+3+4+4	17,6 / 57	21,8 / 69	30,1 / 95	31,6 / 100
	5	26-28	48-50	22-25	0,65	2-2,5	2+3+2+4	15,5 / 49	20,1 / 14	28,5 / 91	31,4 / 100
	6	26-28	48-50	22-25	0,65	2-2,5	2+3+2+6[*]	15,1 / 60	18,2 / 72	24,8 / 98	25,3 / 100
	7	26-28	48-50	22-25	0,65	2-2,5	2+3+2+6[*]	17,4 / 55	21,5 / 72	29,5 / 93	31,8 / 100
III	8	32-34	44-46	28-30	0,65	1,5-2	2+3+4+4	19,7 / 54	22,5 / 70	30,1 / 94	32,0 / 100
	9	32-34	44-46	28-30	0,65	1,5-2	2+3+2+4	17,4 / 54	22,2 / 69	31,0 / 96	32,2 / 100
	10	32-34	44-46	28-30	0,65	1,5-2	2+3+6+4	23,2 / 70	25,5 / 77	31,5 / 95	33,0 / 100
	11	32-34	44-46	28-30	0,65	1,5-2	2+3+4+6[*]	21,0 / 68	22,5 / 73	29,8 / 96	31,0 / 100

Notes. 1). Above the line is the strength of concrete, MPa, below the line -% 2). 6 * Cooling of concrete at an average rate of 3-4 °C/hour for 6 hours was carried out with an open regulating gate of the ventilation duct of the chamber. 3). Concrete in series 1 and 2 are prepared without water heating, i.e. according to conventional technology and pre-conditioned in the workshop for 2 hours under the conditions specified in the table.

From table 1. It can be seen that for all series of experiments the 28-day strength of concrete on portland cement after heat and moisture treatment is 5-9% less than that of normal hardened concrete. The reason for the lack of strength can be two factors. First, heat treatment at high (80 ºC) temperature. It is known that heat is a powerful factor in accelerating the hardening of concrete, but also to a certain extent disturbs its structure due to uneven expansion of the components. This leads to the appearance of stresses in the heterophase system, the appearance of cracks and other microdefects [12, 21]. Secondly, preliminary curing of concrete at a relatively high ambient temperature (25-35 ºC). It was found [1] that the most favorable results are obtained after preliminary curing of freshly formed products on portland cement at a low temperature.
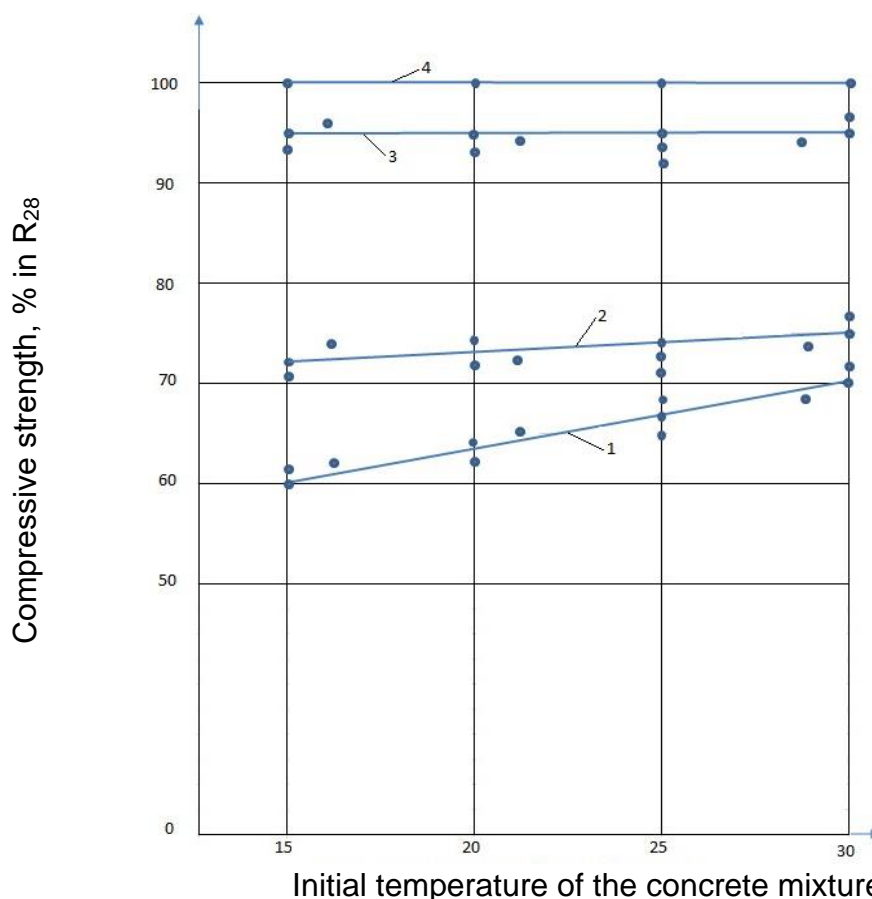
Figure 1: The pattern of the growth in the strength of concrete on Portland cement, depending on the initial temperature of the concrete mixture, which underwent heat treatment according to the mode of 2+3+6+4 hours
1) concrete strength 4 hours after heat and moisture treatment; 2) also, after 3 days; 3) also after 28 days; 4) also after 28 days of normal hardening.

Holding the concrete before heat treatment at a low temperature promotes a greater dissolution of silicate phases [2] and the formation of a smaller number of nucleating crystals but with a well-ordered structure and a high degree of solution saturation [13].

Thus, preliminary curing of concrete on portland cement at a relatively high ambient temperature, on the one hand, leads to a reduction in the preliminary curing time, an increase in the strength of concrete immediately after heat and moisture treatment, on the other hand, slowing down the further hydration of portland cement after heat and moisture treatment.

From table 1. It can be seen that for series 1 and 10, the heating mode, the temperature of isothermal holding and the duration of heat and moisture treatment are the same, but the strength indicators after heat and moisture treatment are different. In this case, the difference in strength indicators can be explained by the degree of maturity of the concrete, since its initial temperature was different and the heating time to the isothermal holding temperature was different.

Concrete with an initial temperature of 30 ^{0}C (series 10) is heated to the isothermal holding temperature for 4 hours, and with an initial temperature of 15 ^{0}C (series 1) for 5.5 hours. Accordingly, by the 4th hour of heat and humidity treatment, the number of degree-hours is 272 (series 10) and 162 (series 1).

217

As a result, by the end of the heat and moisture treatment, concrete with an increased initial temperature gains a large amount of degree-hours (series 10) compared to concrete with a lower initial temperature (series 1) and, accordingly, the strength indicators are 70 and 61% of R_{28nt}.

It should be noted that an increase in the initial temperature of the concrete mixture from 15 to 30 ^{0}C did not lead to a significant increase in the strength of concrete after heat treatment with portland slag cement (Table 2). This is apparently due to the property of the slag, which at relatively low positive temperatures does not show activity in the process of hydration. The unacceptability of slag portland cement for the preparation of warm concrete is also indicated in [14].

The difference between portland slag cement concrete in comparison with portland cement concrete is that the 28-day strength of portland slag cement concrete after heat and moisture treatment for all series of experiments exceeds the strength of the same concrete hardened under normal conditions (Table 2) by 10-20%. The data obtained are fully consistent with the results of [1], which notes that a high heating temperature (80-90 ^{0}C) not only provides high concrete strength immediately after heating, but also does not reduce further intensive growth of concrete strength on slag Portland cement.

From the test results (Tables 1 and 2) it can be seen that the pattern of cooling significantly affects the strength of concrete after heat and moisture treatment. Concrete on portland cement with heat treatment modes 2 + 3 + 4 + 4 = 13 h (series 4, table 1) and 2 + 3 + 2 + 6 * = 13 hours (series 6 and 7, table 1) after heat and moisture treatment gain almost the same strength.

A similar effect is observed for concretes prepared on slag portland cement (series 4 and 6, Table 2). Equal strength indicators of concrete with different isothermal holding times are explained, apparently, by the same degree of maturity. For example, concrete heated according to the 2 + 3 + 6 + 4 hours mode by the end of heat treatment gains the sum of degree-hours equal to 880; the same amount of degree-hours is gained by concrete subjected to heat treatment according to the 2 + 3 + 4 + 6 * hours mode. The total duration of heat treatment in both cases is the same and amounts to 15 hours. But in the second variant, the isothermal holding time is reduced by 2 hours.

From the above, it follows that the increased temperature of the external environment has a beneficial effect on the individual stages of heat and moisture treatment. With an increase in the ambient temperature, the initial temperature of the concrete mix increases, which, at the same rate of temperature rise, contributes to a reduction in the time of this stage in comparison with concrete having a lower initial temperature. Cooling of concrete occurs more slowly due to a decrease in the temperature gradient between concrete and the environment, thereby it becomes possible to reduce the isothermal holding time.

Thermal holding of products after a short isothermal holding can be used especially effectively in hot climates. The increased temperature of the medium reduces heat loss through the enclosing structures of the chambers due to a decrease in the temperature gradient, providing a slower cooling of the products in the chamber. On the other hand, conditions are created for cooling products directly on the operating areas of the shops.

It is advisable to carry out heat and moisture treatment with thermos cooling (two-stage heat and moisture treatment) of products according to two options, depending on the form of labor organization at precast concrete enterprises.

Table 2.

Strength of concrete on slagportland cement under different modes of heat and moisture treatment

Options	№ Series	Environment parameters in thechamber during preliminaryexposure		Initial temperature of concrete mix $T_{c.m.}$, ºC	V / C	Cone draft, sm	Steaming mode, hour	Compressive strength of concrete, MPa through			
		t, ºC	φ, %					4 hours after TBO	3 days	28 days	28 days normal hardening
1	2	3	4	5	6	7	8	9	10	11	12
I	1	15-16	70-75	15	0,65	3-3,5	2+3+8+4	11,4 / 70	13,2 / 81	19,6 / 120	16,3 / 100
	2	20-21	70-75	20	0,65	3-3,5	2+3+6+4	9,6 / 63	11,8 / 77	18,0 / 118	15,2 / 100
II	3	26-28	48-50	22-25	0,65	3-3,5	2+3+4+4	9,3 / 60	11,0 / 71	16,8 / 108	15,5 / 100
	4	26-28	48-50	22-25	0,65	3-3,5	2+3+6+4	9,5 / 65	12,1 / 83	17,1 / 117	14,6 / 100
	5	26-28	48-50	22-25	0,65	3-3,5	2+3+8+4	12,5 / 72	14,5 / 84	20,7 / 10	17,2 / 100
	6	26-28	48-50	22-25	0,65	3-3,5	2+3+4+6*	10,07 / 65	12,5 / 81	18,4 / 119	15,4 / 100
	7	26-28	48-50	22-25	0,65	3-3,5	2+3+6+4	10,1 / 65	12,5 / 81	17,5 / 113	15,5 / 100
III	8	32-34	44-46	28-30	0,65	2,5-3	2+3+8+4	12,5 / 71	14,4 / 82	20,0 / 114	17,6 / 100
	9	32-34	44-46	28-30	0,65	2,5-3	2+3+6+4	10,6 / 67	13,6 / 87	19,0 / 121	15,6 / 100
	10	32-34	44-46	28-30	0,65	2,5-3	2+3+4+4	9,5 / 61	11,3 / 72	17,1 / 109	15,6 / 100

*Notes. one). Above the line - concrete strength, MPa, below the line -% 2). 6 * Cooling of concrete at an average rate of 3-4 ° C / hour for 6 hours is carried out with an open regulating gate of the ventilation duct of the chamber. 3). Concrete in series 1 and 2 are prepared without water heating, i.e. according to the usual technology and pre-conditioned in the shop for 2 hours under the conditions indicated in the table.*

If the molding equipment and heating units are assigned to the shift crew, it is advisable to cool the products in the heat and moisture treatment chambers. In the conditions of two-, three-shift operation, thermos cooling of products after isothermal holding is recommended to be carried out in ripening chambers, since in this case enterprises are interested in increasing the turnover of molding equipment and thermal units.

The expediency of a two-stage heat and humidity treatment for the production of products in areas with hot climates was noted in [15, 16, 17, 18, 19, 20].

Thus, the results of experimental studies prove the correctness of the assumptions on reducing the time of isothermal holding in the process of heat and moisture treatment of concrete in a hot climate. The purpose of the modes of heat and moisture treatment for each specific case, depending on the initial temperature of concrete and the environment, requires a special study. This is a laborious process, takes considerable time and is extremely inconvenient (and in many cases generally unacceptable) for production workers.

Therefore, we proposed an analytical method for optimizing the aging modes of

products during heat treatment, taking into account the temperature of the environment, which is as follows.

The sum of degree - hours is determined for the accepted factory mode, where the temperature of the concrete mixture (t_{c1}) entering the heat treatment unit, according to the current standards, is + 15 ^{0}C:

$$S_1=(t_{is}-t_{c1}) \, (\tau_{lif}{}^1 / 2 + \tau_{is}{}^1), \text{ deg-hour;}$$

Then the sum of the degree-hours of the same mode is determined, but with the actual initial temperature of the concrete (t_{c2}):

$$S_2 = (t_{is} - t_{c2}) \, (\tau_{lif}{}^2 / 2 + \tau_{is}{}^2), \text{ deg-hour;}$$

The ratio of the latter to the former is the optimization factor:

$$K_{op} = S_2/S_1;$$

The duration of the active cycle of heat and moisture treatment of concrete, taking into account K_{op}:

$$T_{op} = T_1 \cdot K_{op} = (\tau_{lif}{}^1 + \tau_{is}{}^1) \cdot K_{op}, \text{ hour}$$

The results of studying the modes of heat and moisture treatment of concrete with different initial temperatures of the concrete mixture and the obtained strength indicators of concrete after heat and moisture treatment confirmed the correctness of the proposed method for optimizing the modes of heat and moisture treatment in the manufacture of precast concrete products in hot climates.

Conclusion. An increased initial temperature (25 ... 30 °C) before heat treatment contributes to a more intensive increase in the strength of concretes during heat and moisture treatment, prepared with Portland cement. For concretes on slag portland cement, it has no noticeable effect.

The strength of concrete prepared on portland cement and slag portland cement is significantly influenced by the nature of cooling; cooling at an elevated temperature (35-40 °C) of the environment proceeds more slowly, reduces temperature gradients in the product, contributes to an increase in the strength of concrete immediately after heat and moisture treatment.

The increased temperature of the environment makes suitable conditions for two-stage heat and moisture treatment. This method is equally effective for concretes based on portland cement and portland slag cement.

The purpose of the modes of heat and humidity treatment of precast concrete products, taking into account the ambient temperature of a hot climate, makes it possible to reduce the active cycle time (temperature rise + isothermal heating) by 2 ... 3 hours. The decrease in energy consumption is 20 ... 22%.

References

[1] Mironov S.A. Temperature factor in concrete hardening. -M.: Stroyizdat, 1948. - 236 p.

[2] Mironov S.A., Malinina L.A. Acceleration of concrete hardening. - M.: Stroyizdat, 1961. - 224 p.

[3] Malinina L.A. Heat and humidity treatment of heavy concrete. Moscow: Stroyizdat, 1977.- 159 p.

[4] Kaiser L.A. Kinetics of hardening of Portland cement under steaming conditions // Trudy RILEM. - M.: Stroyizdat, 1964.-22 p.

[5] Royak S.M., Cherkasova A.F., Yashina E.G. Influence of heat and moisture treatment on hardening of slag Portland cement // Trudy RILEM. - M.: Stroyizdat, 1964.- 21 p.

[6] Investigation of the processes of hydration of Portland cement during heat and moisture treatment at temperatures up to 1000C / PP Budnikov, SM Royak, Yu.S. Malinin, MM Mayants // Truda RILEM. - M.: Stroyizdat, 1964.- 24 p.

[7] Hydration processes during accelerated hardening of cement / TM Berkovich, DM Haiker, OI Gracheva et al. // Proceedings of RILEM. - M.: Stroyizdat, 1964.- 16 p.

[8] Sheikin A.E., Oleinikova N.I. Influence of heat and moisture treatment and fineness of cement grinding on the structure and properties of cement stone // Trudy RILEM. - M.: Stroyizdat, 1964. – 24s.

[9] Josef Riha. Ways to maximum reduction of concrete hardening time / Proceedings of RILEM. - M.: Stroyizdat, 1964. –14 p.

[10] Soroker V.I. Two-stage hardening of concrete and rational consumption of cement - ways to increase the turnover rate of forms in reinforced concrete factories // Trudy RILEM. - M.: Stroyizdat, 1964. -9p.

[11] Stupakov G.I. Acceleration of concrete hardening under the influence of high summer temperatures in the conditions of Central Asia // Trudy RILEM. - M.: Stroyizdat, 1964.-5p.

[12] Krylov B.A. Principles of optimal concreting technology // Sb.tr. - Vladimir, 1985-Concreting with continuous vibroelectric heating of the mixture. - S. 12-15.

[13] Volzhensky A.V., Chistov Yu.D., Garashin V.R. Influence of the hardening temperature on the properties of Portland cement // Cement.-1969. -№8. -FROM. 3-5.

[14] Reinsdorf Z. Acceleration of concrete hardening by heating freshly made concrete mixture (warm concrete). Trudy RILEM. –M.: Stroyizdat, 1964. -15s.

[15] Krylov B.A. Domestic and foreign experience of economical consumption of fuel and energy resources in the production of prefabricated reinforced concrete // Ways to further reduce heat and power costs in the manufacture of precast concrete. –M.: MDNTP. -1988. -FROM. 3-13.

[16] Krylov B.A. ways to save energy costs in the production of precast concrete products // ways to reduce energy costs in the precast concrete industry. –M.: MDNTP. 1981. –S. 3-12.

[17] Rakhimov A.M., Zhuraev B.G., Khakimov Sh.A. An energy-saving method of heat treatment of concrete in hot climates. International scientific journal ISSN 2410-700X. "Symbol of Science". No. 4/2016 Part 3. Russia, Ufa. -FROM. 63-65.

[18] Rakhimov A.M., Khusainov M.A. Sh.Turgunov Stability of concrete on Portland cement and glas Portland cement (GPC) under selected preparation modes. // Materiais da vi conferenciainternacional de investigacao e praticaciensia, Engenharia e tecnologia 4 de julho 2019 Sao paulo, Brazil. "Ciencia, Engtnharia E Tecnologia" №4/2019. Sao Paulo 2019. Publicado por Science WA LTD. BRASIL. 33-39 pp.

[19] Khusainov M.A. Rakhimov A.M.   Strength characteristics of stress-cement concrete (NC) during heat treatment in a bubble-type chamber. **//** International Journal of Progressive Sciences and Technologies (IJPSAT) ISSN: 2509-0119 Vol. 27 No. 1 Junio 2021 y. 131-136 pp.

[20] Rakhimov A.M. Acceleration of concrete hardening. Monograph. - Tashkent; publishing house of Lesson press, 2019. 148 ps.

[21] Khusainov M.A. (2020) Scientific-technical journal (STJ FerPI, Vol.24, (2) pp. 256-259)

DATA PROCESSING ALGORITHM IN REMOTE MONITORING SYSTEM FOR RAW COTTON BUNTS STORED IN WAREHOUSES

NORKOBILOV SALIM

Doctoral student of the Tashkent University of Information Technologies named after Muhammad Al-Khwarizmi
E-mail: norqobilovsalim@gmail.com, phone.: (+99890) 729-61-81

Abstract:

Objective. In order to properly organize good and high-quality storage of raw cotton bunt a long time, it is necessary to divide the cotton into groups, taking into account its moisture content. This article analyzes the remote monitoring of fire hazard indicators (temperature, humidity) for high-quality and safe storage of raw cotton bunts. Algorithm and descriptions of remote monitoring system operation are presented.

Methods. Due to the increase in temperature and humidity of the raw cotton bunt, it has been observed that its quality deteriorates, and it even causes a fire by itself due to heating. As a result, the cotton becomes unusable, which causes great economic damage. In order to prevent these situations, a remote monitoring system was developed.

Results. The structure of the remote monitoring system consists of a device capable of transmitting the results obtained from humidity and temperature sensors in real time from two separate wireless transmission modules. This device transmits data to the Wi-Fi, GSM monitoring center.

Conclusion. The remote monitoring system provides an opportunity to obtain information about the humidity, temperature, and battery power level of the cotton stored in warehouses. It can be widely used to reduce the negative effects on the quality of cotton raw materials stored in warehouses and to prevent the risk of fire.

Keywords: cotton barn, raw cotton bunts, temperature, humidity, Wireless sensor networks, GSM, Wi-Fi, ZigBee, Bluetooth, monitoring system, database, SMS, mobile application, web application.

Introduction. Today, the cotton industry is highly developed in the main cotton-growing countries such as China, USA, India, Pakistan, and Turkey. The Republic of Uzbekistan is among the top ten countries in the world in terms of cotton production, and among the top five countries in terms of cotton fiber quality [14]. There are more than a hundred cotton ginning enterprises and more than four hundred preparation facilities for receiving and seasonal storage of cotton harvest in the republic, where raw cotton is stored for 3-6 months. Constant control and monitoring of temperature and humidity of raw cotton during storage is very important to prevent negative situations [15].

In the cotton mills of Uzbekistan, the temperature and humidity of the cotton are monitored daily by the responsible staff using the devices, and by recording the indicators on the devices in the prescribed form. Including, for high-quality, fire-safe storage of cotton bales stored in open and closed warehouses, it is necessary to constantly measure the temperature and humidity of seed cotton. Various devices are used for monitoring and measuring. It is necessary to carry out measurements with the help of devices and to determine the indicators, to implement the prescribed measures when exceeding the standard condition. In some cases, the number of measuring devices, the time it takes to obtain the results, the calculation of the values of the obtained measurement results, the excess labor force, manual labor, and control are complicated. In addition, when negative situations are detected, quick decision-making, elimination and pre-estimation are very important. It serves to increase work productivity through the use of a remote monitoring system in production enterprises, warehouses, and greenhouses.

Methods. Closed warehouses, semi-open or four-sided open warehouses (porches) and specially prepared outdoor areas are used for cotton storage. A number of prescribed measures are implemented to maintain the quality of

cotton [18]. However, due to adverse weather conditions, precipitation and technical reasons, a part of the cotton grown each year (about 2.5-3%) may be of poor quality due to the temperature and humidity in the cotton gins, as well as due to technical safety. [16]. The dimensions of the garden areas are 25x14 m, the height should be 0.4 m above the ground level, and it should be raised by 0.05-0.07 m to ensure the drainage of rainwater. (Figure 1).

Figure 1. Raw cotton bunts stored in the open field: a) the appearance of the initial acceptance, b) the appearance of precipitation in the winter season.

Table 1

Technical characteristics of raw cotton during preparation

Cotton variety	Cotton moisture, percent	The height of the cotton pile, meter	Approximate mass of raw cotton in the area, tons
I	**up to 9**	**8**	**400**
	9,1-12,0	**8**	**350**
	12,1-14,0	**7**	**300**
	above 14	6	250
II	**up to 10**	**8**	**370**
	10,1-13,0	**8**	**300**
	13,1-16,0	**7**	250
	above 16	6	200
III	up to 11	7	350
	11,1-15,0	7	300
	15,1-18,0	6	230
	above 18	6	200
V	**up to 13**	**6**	**270**
	13,1-17,0	**5**	**200**
	17,1-20,0	4	190
V	above 20,1	4	60-90

In order to properly organize good and high-quality storage of raw cotton for a long time, it is necessary to divide the cotton into groups, taking into account its moisture content. When the moisture content is up to 14%, it can be packed into shards. The technical characteristics of cotton when packed into garams should not exceed the following indicators (Table 1) [6].

At the same time, measuring and controlling the temperature of raw cotton bunts is carried out by a group of supervisors consisting of 5-6 people. In this case, the supervisors record the temperature at eight points of the bunts where the measurements were made, and based on this, they determine the average temperature of the raw cotton bunts. It takes a long time, measuring one cotton bales takes about 3-4 hours. It takes a lot of time for measurements, causes a lot of complications in determining it in the case of sudden changes in temperature and humidity inside the chamber as a result of external influences. If only the temperature of the cotton bales is measured [9], the remote measurement device developed and used in the experimental tests gives the possibility to measure the temperature and humidity at the same time Fig. 2.

Due to the increase in temperature and humidity of the aw cotton bales, it has been observed that its quality deteriorates, and it even causes a fire by itself due to heating. As a result, the cotton becomes unusable, which causes great economic damage. In order to prevent these situations, a remote monitoring system was developed [10].

Today, wireless sensor networks WSN (Wireless Sensor Networks - wireless sensor networks) are used for remote monitoring [19]. Monitoring based on WSN is aimed at obtaining measurements of temperature, pressure, wind speed, humidity and other parameters, remote control, and processing of the obtained results. Therefore, the transmission of information from devices through communication networks provides control, early detection of negative situations, and effective management [1].

WSN is a network of sensors that monitor and record the physical state of the environment and transmit the collected data to the center via radio waves. Data obtained from WSN can be organized as wireless transmission and wireless ad-hoc

networks [5]. A WSN is bidirectional and allows for data collection and sensor operation management. Such networks are used in production process control, system monitoring, agricultural, industrial and user applications [4].

Using WSN, dedicated sensors are used to measure the temperature and humidity of cotton bales. In wireless sensor networks, many wireless technologies such as Wi-Fi, Bluetooth, ZigBee are used for data transmission and network organization. The technical characteristics of these wireless technologies are presented in Table 2 [2].

Table 2.

Analysis of specifications of wireless technologies

Technical characteristics	Wireless technology name		
	Wi-Fi	**ZigBee**	**Bluetooth**
Operating distance	100-150 m	50-1600 m	10-100 m
The number of nodes in the network	2007	264, 65536	8
Power supply	12-24 hours	12-14 months	6-12 months
Connection time	3 sec	30 ms	10 sec
Type of communication	DSSS	DSSS*	FHSS**
Frequency range	2.4GHz, 5GHz	850-930MHz	2.4 GHz
Data transfer speed	300-600 Mb/s	250 kbps	10 Mb/s

Results. It is sufficient to measure the temperature and humidity of the observed raw cotton bunts once a day. The proposed monitoring system was developed taking into account the need for information, along with daily measurements, when the indicators increase or decrease from the specified norm [7]. In order to compare the developed device and the currently used ТЭ-100 thermoshup [8] device, an experimental test was conducted to measure the temperature of raw cotton bunts (Fig. 3).
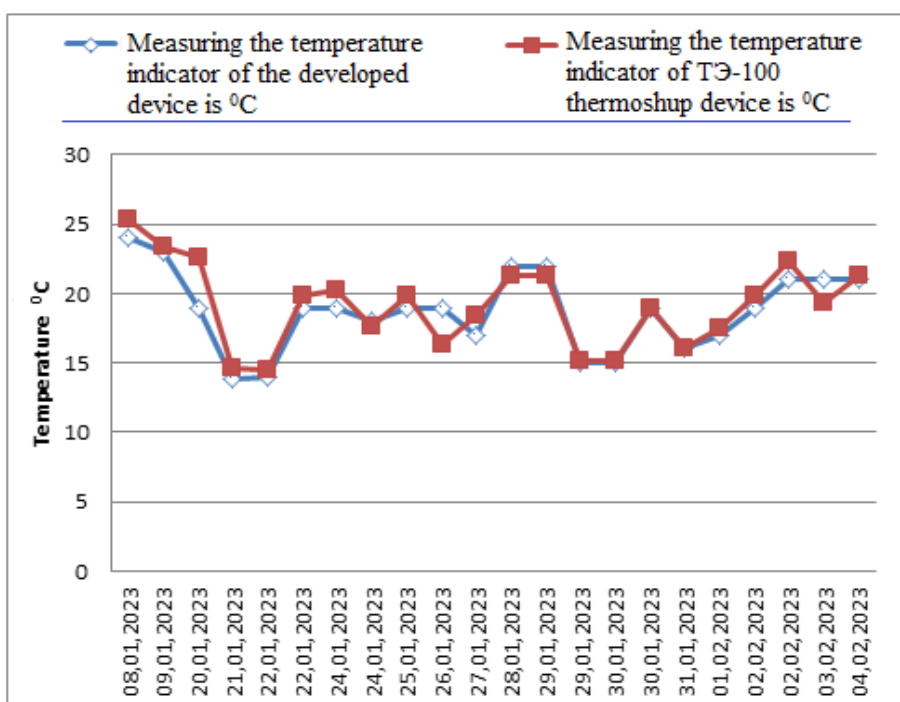
Figure 3. Test graph for measuring the temperature of cotton bunts

The results from the devices showed a measurement error of up to 1^{0}C. However, the developed device showed advantages over the analogue device in practice, as it required less time to obtain the result during the pilot-testing period and to transmit data to the remote monitoring system.

The structure of the remote monitoring system consists of a device capable of transmitting the results obtained from humidity and temperature sensors from the network in real time from two separate wireless transmission modules (Fig. 4). This device transmits data to the Wi-Fi, GSM monitoring center [11,12].
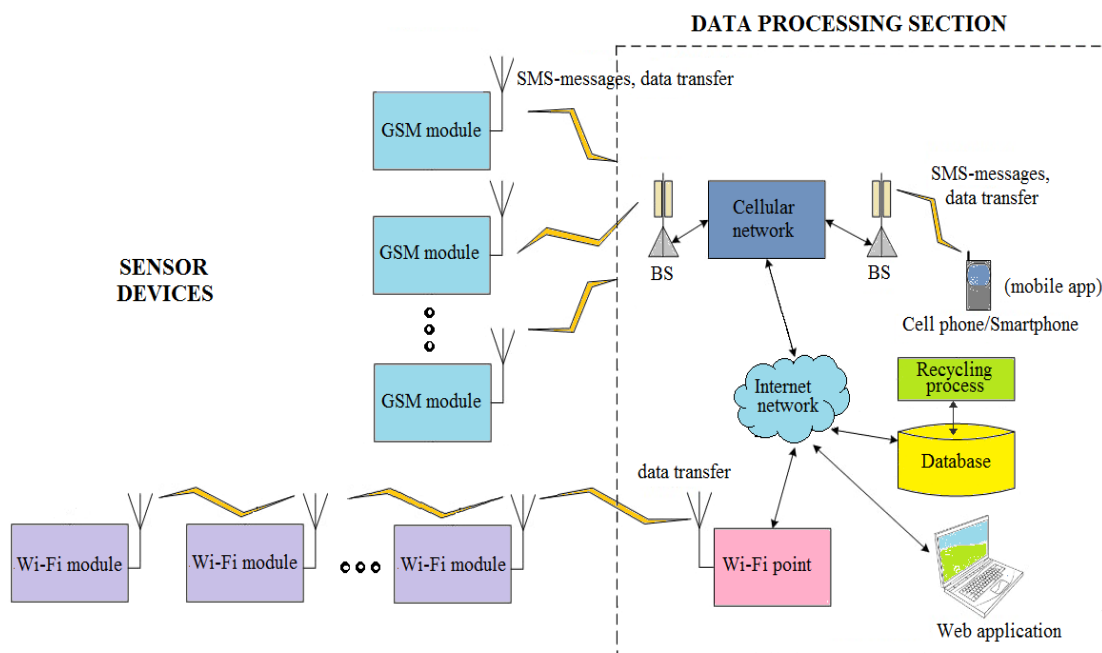
Figure 4. Remote monitoring system of temperature and humidity of raw cotton bunts warehouses

The developed remote monitoring system consists of sensor devices installed on cotton bales and a computer server connected to a wireless network. In case of increase or decrease from the target value, the results will be provided remotely. The received pointers are saved to the database after processing. The data reflecting the current status of the monitoring system is based on statistical analysis and is displayed in the web application and the mobile application. The data is transmitted to the monitoring center and the system provides the operator with online and temperature and humidity data from the monitored equipment for real-time display [13].

Thus, the operator has the latest and most accurate information about the indicators received from the monitored devices. A monitoring system algorithm was developed to control the operation of the monitoring system and process the data of its devices [17].

The data processing algorithm of the remote control devices of raw cotton bunts warehouses is presented in Fig. 5.
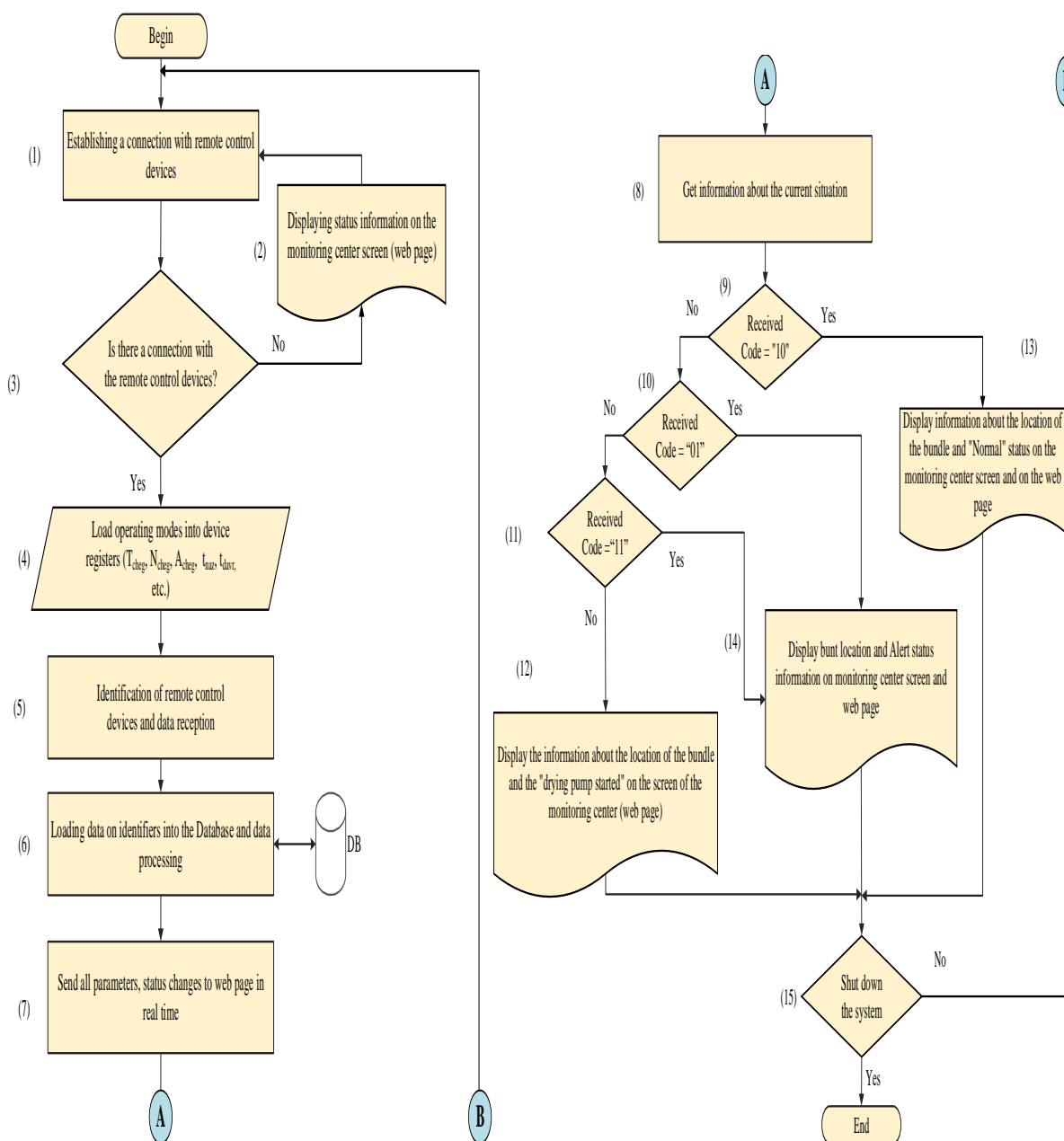
Figure 5. Algorithm of data processing of remote control devices of raw cotton bunts warehouses. (1st version)
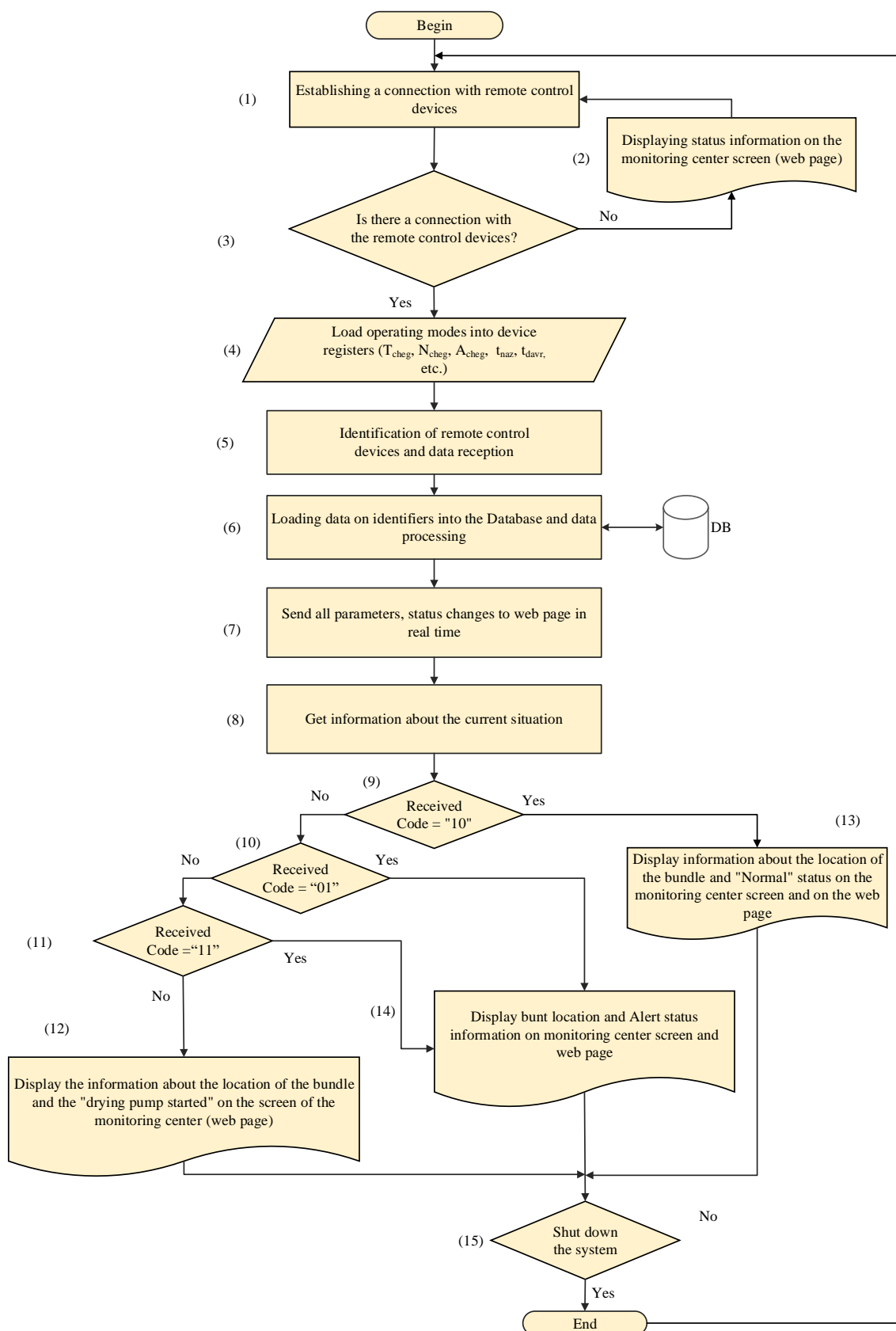
Figure 5. Algorithm of data processing of remote control devices of raw cotton bunts warehouses

The sequence of operation of the proposed algorithm for data processing of remote control devices of raw cotton bunts warehouses and the block diagram of the algorithm are presented in Figure 5. The sequence of operation of the algorithm:

Step 1. Establishing a connection with remote control devices

Step 2. Displaying status information on the monitoring center screen (web page).

Step 3. If communication with remote control devices is available, go to step 4, otherwise go to step 2.

Step 4. Operating modes (T_{cheg}, N_{cheg}, A_{cheg}, t_{naz}, t_{davr}, etc.) are loaded into device registers.

Step 5. Device operating modes (date, control time, periodicity, etc.) are loaded.

Step 6. Identification and data of remote control devices are accepted.

Step 7. Data on identifiers (DB) is loaded into the database and the data is processed.

Step 8. Get information about the current situation.

Step 9. If Received Code = "10" go to step 13, otherwise go to step 10.

Step 10. If Received Code = "01" go to step 14, otherwise go to step 11.

Step 11. If Received Code = "11" go to step 14, otherwise go to step 12.

Step 12. Information about the location of the bundle and the fact that the "air suction pump has started" is displayed on the screen of the monitoring center (web page).

Step 13. Information about the location of the bundle and the "Normal" status is displayed on the monitoring center screen and on the web page.

Step 14. Bunch location and Alert status information is displayed on the monitoring center screen and web page.

Step 15. If it is necessary to terminate the system operation, the operation is terminated, otherwise it goes to step 1.

The data processing algorithm of remote monitoring devices takes into account the amount of precipitation, changes in the temperature and humidity of the warehouse where cotton is stored, the amount of battery power, time control, periodicity, changes in the operating mode and other conditions during developed [12].

Discussions. The controller can download the current status of the monitored raw cotton goods, and if necessary, the daily, weekly or monthly report from the system in electronic form. In addition, the statistical data stored in the database are displayed graphically (Figures 6, 7).
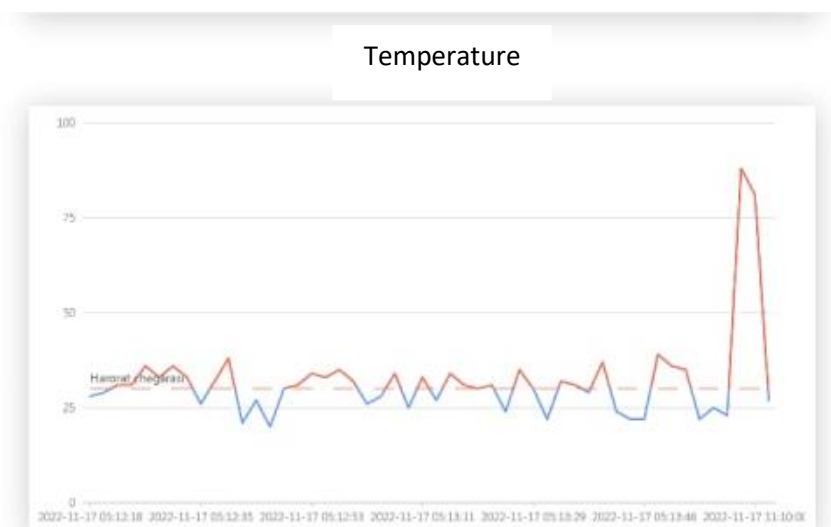
Figure 6. Graphic display of the temperature of the observed raw cotton balls in the web application
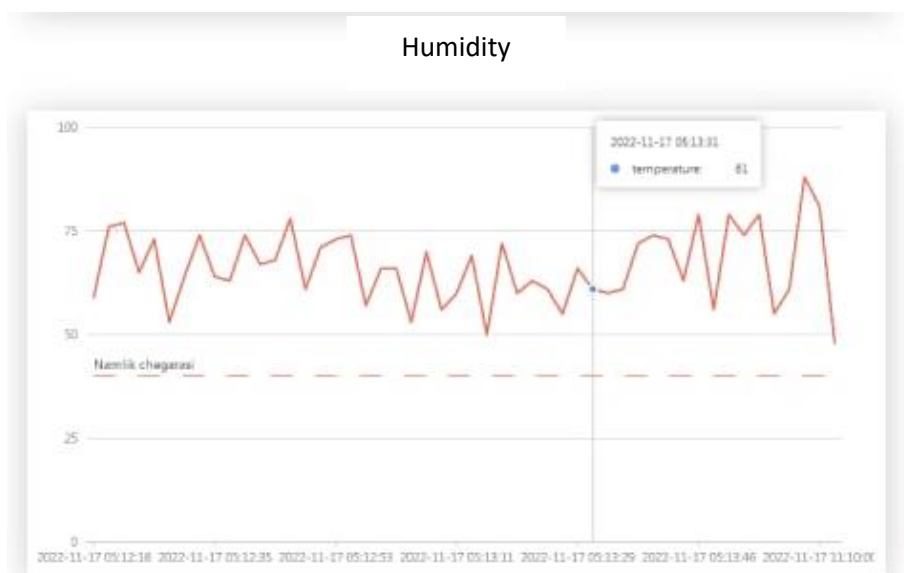
Humidity

Figure 7. Graphic representation of the moisture content of the observed raw cotton bales in the web application

In the monitoring system, the controller can see the temperature and humidity, the capacity of the device, or receive information in the form of an SMS-message by sending a request through a mobile device.
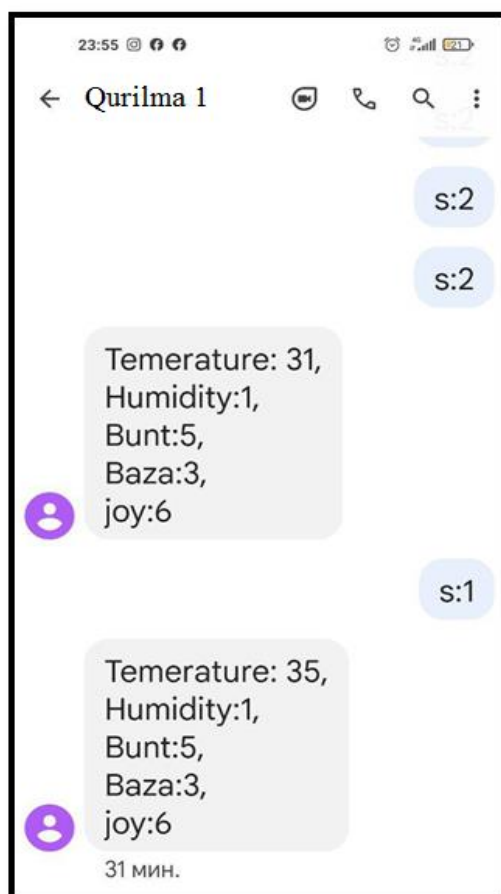
Figure 8. Receive information about the temperature and humidity of raw cotton bunts in the form of an SMS-message

Also, an automatic warning function is required in case of exceeding or decreasing the specified values. The system sends emergency warning messages to operators in the form of an SMS-message and simultaneously in the form of a warning message in the web application [20]. The supervisor who received this message gives an opportunity to develop practical measures and eliminate negative situations in a timely manner [21].

Conclusion. Based on the data processing algorithm of the system of remote monitoring of the raw cotton warehouses condition, measuring the fire hazard indicators of raw cotton bunts, the impact of the environment, receiving, processing and timely measurement results of the developed devices notification, implementation of appropriate measures in necessary cases, and most importantly, the operation of the monitoring system based on wireless technologies was achieved. All parameters related to system performance are fully covered. The remote monitoring system collects information about the humidity, temperature, and battery power of the device stored in warehouses. It allows to configure, evaluate, and predict operating modes using wireless networks. It can be widely used to reduce the negative effects on the quality of cotton raw materials stored in warehouses and to prevent the risk of fire.

REFERENCES.

1. Davronbekov D.A., Pulatov Sh.U., Sultonova M.O., Aliyev U.T., Tashmatov E.B., "Simsiz keng polosali texnologiyalar". Darslik. Toshkent –"Aloqachi" – 2018.

2. Ibraimov R.R., Davronbekov D.A., Sultonova M.O., Tashmatov E.B., Aliyev U.T., "Simsiz aloqa tizimlari va dasturlari". Darslik (1-qism). Toshkent –"Aloqachi" – 2018.

3. Davronbekov D.A., Norqobilov S.A., Alimdjanov X.F. Features of the use of wireless touch technology in the prevention of emergencies // InterConf. Proceedings of the 2nd International Scientific and Practical "Conference Scientific community: interdisciplinary research" Germany, Hamburg - 2021. - p.672-678https://ojs.ukrlogos.in.ua/index.php/interconf/issue/view/26-28.01.2021/425.

4. Ullo, Silvia Liberata; Sinha, G. R. (2020-05-31). "Advances in Smart Environment Monitoring Systems Using IoT and Sensors". Sensors. 20 (11): 3113. Bibcode:2020Senso. 20.3113U. DOI:10.3390/s20113113. ISSN 1424-8220. PMC 7309034. PMID 32486411.

5. Global, I. G. I. "Wireless sensor networks have potential in health care and agriculture, says study". techxplore.com. Retrieved 2023-02-09.

6. M. F.Otaboyev, D.O.Xidirova Paxta xom ashyosini saqlash jarayonida harorat o'zgarishini tola sifatiga ta'siri va xom ashyoni quritish va tozalashni ilmiy jixatdan tahlil qilish // Eurasian Journal of Law, Finance and Applied s Ciences. Innovative Academy Research Support Center, Volume 2 Issue 6, June 2022 https://doi.org/10.5281/zenodo.6673297.

7. Davronbekov D.A., Norkobilov S.A. Remote Monitoring of the Temperature and Humidity of the Stored Cotton Barn // International Conference on Information Science and Communications Technologies ICISCT 2022 Applications, Trends and Opportunities, 2022, Uzbekistan http://icisct2022.org/openconf/openconf.php

8. Никитин Р. П., Кушакеев Б. Я., Гуляев Р.А., Каримов З.С., Ахмедов А.А., Краев Д..Н., Файнбойм В.М. "Ҳароратни аниқлаш учун асбоб термощуп." // Фойдали моделга патент № FAP 00749. Ўзбекистон Республикаси интеллектуал мулк агентлиги, Тошкент, 31.08.2012й.

9. Isroilov J.D., Norkobilov S.A., Davronbekov D.A., Shamsiyev A.S., Features application of sensor networks for measurement of raw cotton bunts // International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities. ICISCT 2021, Uzbekistan https://ieeexplore.ieee.org/document/9670181 DOI:10.1109/ ICISCT 52966. 2021. 9670181

10. Davronbekov D.A., Norkobilov S.A., Sharipov X.R., Norkobilova F.A., Xayrullayev A.F. "Paxta g'aramlaridagi harorat va namlikni masofadan o'lchash dasturi (Wi-Fi tarmoq orqali)" dasturi, O'zbekiston Respublikasi intellektual mulk agentligi. Elektron hisoblash mashinalari

uchun yaratilgan dasturning rasmiy roʻyxatdan oʻtkazganligi toʻgʻrisidagi guvohnoma № DGU 20391. 15.12.2022

11. Давронбеков Д.А., Норкобилов С.А., Хасанбаев Р. Д., Норкулова Д.Р. "Программа для дистанционного измерения температуры и влажности бунтов хлопка (по сотовой сети)" // Свидетельство об официальной регистрации программы, созданной для электронно-вычислительных машин. Министерство юстиции РУз, №DGU 18888. 24.10.2022 г.

12. Davronbekov D., KhujamatovKh., Norkobilov S., Isroilov J. Features of Using the Energy-Saving LEACH Protocol to Control the Temperature of Stored Cotton Piles via a Wireless Network of Sensors // International Journal of Discoveries and Innovations in Applied Sciences, Spain October-2021 Published under Volume: 1Issue: 5 in p.278-282 http://openaccessjournals.eu/index.php/ijdias/article/vi-ew/477/466

13. Davronbekov D.A., Alimdjanov X.F., Isroilov J.D., Norkobilov S.A., Axmedov B.I. Analysis of features of wireless sensor networks // Proceedings of the 7th International Scientific and Practical Conference «Scientific Horizon in The Context of Social Crises» (Febryary 6-8, 2021) at Tokyo, Japan. p.1052-1059 https://ojs.ukrlogos.in.ua/index.php/interconf/article/view/8836/8793

14. Xalq soʻzi gazetasi "Ўзбекистон пахтаси сифати бўйича дунёда "кучли бешлик"да" 18.09.2019 online nashrdan: xs.uz/uzkr/post/ozbekiston-pakhtasi-sifati-bojicha-dunyoda-kuchli-beshlikda.

15. https://www.researchandmarkets.com/reports/5265146/global-cotton-market-and-volume-by-consumption#src-pos-1.

16. https://paxtasanoatilm.uz/paxta-uni-qabul-qilish-va-saqlashni-tashkil-etish/

17. D. C. Tranca et al., "Industrial WSN node extension and measurement systems for air, water and environmental monitoring: IoT enabled environment monitoring using NI WSN nodes," 2017 16th RoEduNet Conference: Networking in Education and Research (RoEduNet), 2017, pp. 1-6, doi: 10.1109/ROEDUNET.2017.8123750.

18. T. Lazarescu, "Design of a WSN Platform for Long-Term Environmental Monitoring for IoT Applications," in IEEE Journal on Emerging and Selected Topics in Circuits and Systems, vol. 3, no. 1, pp. 45-54, March 2013, doi: 10.1109/JETCAS.2013.2243032.

19. C. Yu, J. Hu, R. Li, S. Deng and R. Yang, "Node Fault Diagnosis in WSN Based on RS and SVM," 2014 International Conference on Wireless Communication and Sensor Network, 2014, pp. 153-156, doi: 10.1109/WCSN.2014.38.

20. Karimov Abdusamat Ismonovich, Ismanov Muhammadziyo. Mathematical Modeling of Heat Flux Distribution in Raw Cotton Stored in Bunt // International Journal Engineering DOI: 10.4236 / Vol.12 No.8, August 2020 eng. 2020. 128041. https://www.scirp.org/journal/paperinformation.aspx?paperid=102304

21. Halim Khujamatov, Temur Toshtemirov. Wireless sensor networks based Agriculture 4.0: challenges and apportions // 2020 International Conference on Information Science and Communications Technologies (ICISCT), Tashkent, Uzbekistan – 2020. DOI: 10.1109/ICISCT50599.2020.9351411

PROSPECTS FOR THE DEVELOPMENT OF SERVICE INDUSTRIES

BEKMIRZAYEV MIRZOHID

PhD of Namangan Institute of Engineering and Technology
E-mail: mirzo1979@umail.uz Tel.: +998 91 292 75 55

XOLIKOV JAVOHIR

Master student of Namangan Institute of Engineering and Technology

Abstract:

Objective. In this article, the development of the service industry in the conditions of ensuring economic stability, increasing its importance, the economic analysis of the activity of the service industry today, and the further development of the service network in the future are described in detail. Service sector - part of the economy, which includes all types of commercial and non-commercial services; a consolidated general category that includes the reproduction of various types of services provided by enterprises, organizations, and individuals. It is customary to include culture, education, health care, and consumer services in the service sector. The service sector is often referred to as a post-industrial economic structure due to their well-developed modern infrastructure. It is the service sector that, in economically developed countries, makes up the bulk of the economy in terms of the number of employees. The service sector includes: the service sector (infrastructure services for the production and service sectors of the economy) and the social sector (services for the non-production and legal and financial sectors of the economy).

Methods. The research consists of further development of service industries in our country, identification of factors affecting their sustainable development, development of scientific and practical proposals and recommendations based on the study of the experience of foreign countries on sustainable economic development.

Results. In our country, the rapid development of the service sector, as in all other sectors, is a constant focus. In our country, in particular, in the Namangan region, a number of necessary measures aimed at the development of the service sector are being implemented and sufficient conditions are being created.

In the period 2017-2021, the total volume of services in Namangan region increased by 1.6 times, and services per capita increased from 1896.0 million soums in 2017 to 2451.7 million soums by 2021. In particular, financial services saw 4.8 times higher growth rates, transport services 1.8 times, and educational services 2.5 times higher.

Last year, 1,424 legal entities were registered in the field of services in Namangan region, which made up 23.2 percent of the total number of registered legal entities. 8506.7 trillion in the service sector in 2017-2021. 33,950 new jobs were created in return for the implementation of 1,404 projects worth 1,404 soums, and the number of investment projects increased 10 times. By 2026, the volume of services is expected to increase by 2.5 times in real terms.

Conclusion. In order to further develop the service sector in the future, it is appropriate to implement a number of measures, in this regard, it is necessary to further strengthen the activity of entrepreneurs in the service sector, create the necessary conditions, attract young people from among the graduates of vocational colleges and higher education institutions to family business entities.

Keywords: service sector, service sector, social sector, digital economy, increasing the role of services in the national economy, the service sector market.

Introduction. Using the term "service sector", which is very widely used in many publications (both scientific and journalistic), the authors put different meanings into it, interpret it with varying degrees of breadth and detail. This is largely due to the fact that the phenomenon of the service sector in a fairly holistic, systemic, more or less mature form was formed and began to play its role relatively

recently. Therefore, theoretical economists engaged in a thorough study of the service sector only in the second half of the 20th century. In Western countries, this happened in the 60-70s of the XX century, in our country, formally, also during this period, although from the standpoint of a command economy, but real, vital, practical (scientific and practical) interest began to appear and intensify only in recent years. decade of the twentieth century, when the realization of the importance and complexity of this sphere of social production came. Research is carried out both at the deep level and in applied terms, and the applied direction is still more advanced (especially in the framework of marketing), and the least developed is the direction of economic theory.

Methods. The research consists of further development of service sectors in our country, identification of factors affecting their sustainable development, development of scientific and practical proposals and recommendations based on the study of the experience of foreign countries on sustainable economic development.

Specific characteristics and initial aspects of the services market were studied by foreign scientists: A. Smith, D. Ricardo, J.B. Sey and other economists, as well as local scientists it was studied by Sh. Shodmonov, B.A. Abdukarimov, J. Bobonazarova, Sh. Kuvandikov, Y. Aliev, etc.

Results. One of the most important patterns of economic development throughout the world is the relationship between economic growth and the increasing role of services in the national economy. This finds expression in an increase in the share of labor, material and financial resources used in the service sector.

With the development of society, the growth of productive forces, a certain development of the service sector market takes place. There is an increase in employment in this area, an increase in the

technical equipment of labor, the introduction of more and more advanced technologies. At present, the role of services, as one of the most important sectors of the economy, is very large and relevant. This is due to the complication of production, the saturation of the market with goods of both everyday and individual demand, with the rapid growth of scientific and technological progress, which leads to innovations in the life of society. All this is impossible without the existence of information, financial, transport, insurance and other service markets.

At present, the role of the services market, as one of the most important sectors of the economy, is very large and relevant. This is due to the increasing complexity of production, the saturation of the market with new products, and the rapid growth of scientific and technological progress. All this is impossible without the existence of information, financial, insurance and other service markets. There is an expansion of the bases for the reproduction of market and non-market services, and market ones are winning an increasingly significant share for themselves in the total volume of services. This is due to the trade in goods (especially technically complex ones), since the sale of goods requires an increasingly developed network, which consists mainly of services provided during the sale and, after-sales services. The increase in demand for various types of services is explained by the influence of a number of factors. Services are purchased by both individuals and organizations. In the first case, they are called consumer, in the second - industrial.

Reasons for the rise in consumer services:

1. The growth of the welfare of the population. Under the influence of this reason, the desire of consumers to facilitate such routine work as cleaning,

cooking, washing, etc. has increased, which has led to the flourishing of the service market.

2. The emergence of free time due to the reduction of the working week in many countries of Western Europe and the USA.

This factor has led to an increase in demand for leisure and sports related services. There was a problem of free time. As a result, various interest clubs arose, studying at various schools.

3. The growth and use of high-tech products in the home (computers, video equipment, mobile communications, etc.) has led to an increase in the need for specialist installation and maintenance services.

4. The development of the market and market relations increases the need for companies in consulting services (market research, marketing developments, audit, etc.)

5. The complication of technology has led to the emergence of engineering services, i.e. technical services and technical advice. Engineering (English engineer - to design, build) - the provision of industrial, commercial, scientific and technical services by specialized engineering and consulting firms.

6. Increased competition. To remain competitive, industrial companies are forced to cut fixed costs. It is economically more profitable to buy a ready-made service, rather than incur additional costs associated with the independent implementation of narrow specialized tasks. Companies are willing to buy services because it avoids additional investment in their fixed assets and thus maintains their flexibility. For example, services for incoming control of raw materials, complex instrumental control of products.

7. More and more companies tend to concentrate their activities in highly specialized areas. Therefore, they abandon auxiliary activities such as warehousing, transportation, packaging, etc. Firms reduce their activities in such unusual areas as capital construction (departments of capital construction), transport and repair of equipment, etc.

Foreign experience shows that tourism plays an important role in the economic development of the country. The share of tourism in GDP in Uzbekistan is about 2.5 percent. In developed countries with a large tourism sector, this figure is up to 10 percent, in island and developing countries, the share of tourism is from 30 to 50 percent. Tourism accounts for 8 percent of world exports of goods and services. In 83 WTO member countries, tourism is among the top five export sectors, while in 38 percent of the world's countries it is the main source of foreign exchange earnings. In addition, in countries where tourism is considered an important part of income, it has become the main area of employment.

According to the WTO, in the third millennium, the demand for tourism products that provide the most satisfaction in the shortest period of time will be high. Uzbekistan has all the necessary resources for the development of tourism: monuments of ancient historical architecture and oral art of the people, reserves, natural landscapes, etc. The concept of the Development Strategy of Uzbekistan until 2035 is expected to increase the share of tourism in GDP from 1.4 to 28 percent.

In the field of improving the activities of economic entities, it is necessary to pay special attention to the economies of scale and the development of private entrepreneurship in this area.

The expansion of the scale of production makes it possible to use advanced technologies and high-quality high-tech equipment. As the scale of production increases, it becomes possible to take advantage of specialization in

production and management, which leads to higher incomes in the industry, the creation of additional jobs and higher wages for workers in the industry.

Discussion. The following measures are expected to be implemented to ensure stable growth rates in the service sector:

1. Activities in the social sphere. In doing so, after studying the activities of existing schools and pre-school education, health care and cultural and sports institutions in the region, the scope of providing social services to the population will be doubled by involving the private sector in unused vacant buildings and structures and land areas.

2. Development of tourism services. According to this, Chodak ecotourism cluster was established in the territory of Pop district, and this complex is aimed at providing high-quality and diverse services to tourists, increasing the flow of tourists, and providing employment to local residents. This cluster includes camping and glamping, alpinism and trekking, horse riding and mountain excursions, family guesthouses, tourism information center and tourism information indicators. As a result, the number of tourists visiting will increase from 150,000 to 250,000, 450 new jobs, 50, Service volumes of 0 billion soums and an average of 10.0 billion soums of receipts to the local budget are expected.

In addition, in the territory of the Nanay village of the Yangikurgan district, the establishment of recreation centers and an ecotourism cluster has been started, thereby increasing the flow of tourists to the region.

In particular, the number of facilities serving tourists will be brought to the level of demand, taking into account the demands and visits of tourists over the years. In this case, accommodation for tourists will be organized in hotels, guest houses, increasing the number of tour operators, expanding the activities of tourist information centers, increasing Wi-Fi internet zones.

Through this, the number of tourists visiting the region is 1.7 million. from 7.4 million people, it is planned to increase the export of tourism services from 5.4 million dollars to 65.0 million dollars.

3. Construction of large trade and service facilities in cities and districts, expansion of activities of markets and amusement parks. In this regard, establishment of a culture and recreation park by "Namangan Independence Park" LLC in Namangan city, establishment of hotels by "Merrymed farm" LLC and "Istiqlol Javakhiri" LLC in Namangan city, organization of logistics center by "J-United Group" LLC in Namangan district , establishment of a jewelry center by "GAVHAR JEWEL GROUP" enterprise in Namangan city, establishment of a shopping complex by "AMINJON OTA NURIDDINOV FARMERS' MARKET" LLC in Namangan district, establishment of a shopping complex and showroom by "ART SOFT TOWER" LLC in Namangan city. Also, establishment of a medical hospital by "Hurriyat Sevinch Medical Center" LLC in Uchkurgan district, establishment of a diagnostic center of "Shodlik Med Servis" LLC in Uchkurgan district, establishment of a modern medical center by "Merrymed farm" LLC in Namangan city, "Namangan Premium Invest" in Namangan city " Namangan Square residential complex will be established by LLC, "Namangan Outstanding Square" complex will be established by "Namangan Qianxing Investment" LLC in Namangan, and a sanatorium and health center will be established by "Al Hamdani group" LLC in Chortoq district.

Conclusion. In order to develop the services sector in the future, it is appropriate to implement the following measures:

- Achieving a fundamental change in the composition of the provided services at the expense of modern high-tech types;

- Development of service enterprises in rural settlements;

- increasing attention to communal and household, housing repair and construction, preparation of agricultural products;

- Creation of necessary conditions for strengthening the activity of entrepreneurs in the field of service provision, attracting young people from among graduates of vocational colleges and higher educational institutions to family business entities;

- Rapid development of new promising types of consulting, banking, finance, insurance, leasing and evaluation services, which are in high demand among the population;

- Pay special attention to the training, retraining and upgrading of the personnel working in the service sector.

References

1. Сидоров А.А. Развитие сферы услуг в условиях цифровой трансформации национальной экономики // Теоретическая и прикладная экономика. 2021. № 1. – С. 39 - 47.

2. N.X.Xalilov, N.T.Safina. "The need to include gemification elements in the educational process". JournalNX - a Multidisciplinary Peer Reviewed Journal. (ISSN No.(E):2581-4230) Maharashtra India. 2021.

3. Adashaliyevich, B. M., & O'g'li, I. M. (2022). Promoting sustainable development of small business. Asian Journal of Research in Business Economics and Management, 12(4), 5-9.

4. Бекмирзаев, М. А., & Холиков, Ж. Т. У. (2022). Важность развития сферы услуг в Республике Узбекистан. In Colloquium-journal (No. 4 (127), pp. 18-21). Голопристанський міськрайонний центр зайнятості.

5. М. Бекмирзаев. (2022). Тадбиркорликни ривожлантириш асосида камбағаллик даражасини камайтириш йўналишлари. Архив научных исследований, 2(1). извлечено от http://journal.tsue.uz/index.php/archive/article/view/2105

6. Adashaliyevich, B. M., & Gaybullajon o'g'li, I. M. (2023). Main directions of sustainable development of small business and private entrepreneurship. Scientific approach to the modern education system, 2(13), 107-112.

7. Adashalievich, B. M., & Toxirovich, M. B. (2023). Small business and private entrepreneurship-development guarantee. Innovative achievements in science 2022, 2(16), 73-78.

8. Adashaliyevich, B. M., & Abdurahimkhoja o'g'li, A. A. (2023, February). Ways of innovative development of the activities of small business and private business subjects. In International scientific research conference (Vol. 1, No. 11, pp. 90-95).

9. Toxirjon o'g'li, H. J., & Adashaliyevich, B. M. (2023). Prospects for development of the services field. Innovation in the modern education system, 3(27), 274-279.

10. Хайиталиев, О., & Бекмирзаев, М. (2023). Иқтисодиётни глобаллашуви шароитида камбағаллик муаммосини камайтиришнинг ҳудудий жиҳатлари. O'zbekistonda fanlararo innovatsiyalar va ilmiy tadqiqotlar jurnali, 2(16), 597-602.

UDC 339.564:338.45.025 (575.121)

ORGANIZATIONAL AND ECONOMIC MECHANISMS TO SUPPORT THE EXPORT OF INDUSTRIAL PRODUCTS: A COMPARATIVE ANALYSIS OF FOREIGN EXPERIENCE AND PROPOSALS

ILYOSOV ASRORJON

Senior teacher of Fergana Polytechnic Institute
E-mail: i.asror@ferpi.uz, phone.: (+99890) 163-33-03

Abstract:

Objective. The purpose of the study is to analyze the organizational and economic mechanisms related to the state support of industrial exports in the developed countries of the world and to identify the main trends.

Methods. The organizational and economic mechanisms of the export of industrial products used by the developed-leading exporting countries are classified using the method of comparative analysis. Analyzing the organizational and economic mechanisms of the export of industrial products, the positive aspects of using these mechanisms in the economy of our country were determined.

Results. The organizational and economic mechanisms of the export of industrial products are analyzed, and a comparative description of the mechanisms for supporting the export of industrial products in developed and leading exporting countries is based.

Conclusion. Based on the further improvement of the organizational and economic mechanisms of effective support of the export activity by the state, which is shown by the experience of developed countries, it is possible to take a place among the countries that supply competitive products in the foreign market.

Keywords: export of industrial products, organizational mechanisms, economic mechanisms, legal mechanisms, administrative mechanisms, financial mechanisms.

Introduction. Globalization processes in the world economy show that in recent years, the growth of exports of goods lags behind the growth of the world gross domestic product. Factors related to socio-economic development and competitiveness, there is a need to achieve sustainable economic development by improving the organizational and economic mechanisms of export of industrial products. According to the World Trade Organization (WTO), "world trade in goods decreased by 5.3% in 2020 and by 3.0% in 2019, significantly lower than the 2.9% increase in 2018. By 2022, it is predicted that world trade in goods may decrease to 4%[2]. The decline in total goods trade is mainly due to the decrease in the export of industrial products. Industrial products constitute the main part of the export of goods. Therefore, in the development of world trade, the growth of the export of industrial products has priority, which requires further improvement of organizational and economic mechanisms in the field.

Methods. Systematic analysis, synthesis, statistical grouping, expert assessments and other methods were used in the research.

Results. In our opinion, the export support under state guarantee-insurance and credit guarantee plays an important role in the export of complex technological, capital-intensive and industrial products to foreign markets. In practice, participants of various tenders and competitions with such support can get financing on more favorable terms, which in turn creates a greater chance of success.

Organizational mechanisms, which include a number of means and mechanisms for helping exporters, are

---

[2]

https://www.wto.org/english/res_e/statis_e/wts2020_e/wts2020_e.pdf

effectively used as one of the main elements of state support for exports.

Table 1.

Comparative description of export support mechanisms in developed countries[3]

№	Mechanisms	USA	Great Britain	Germany	Japan	South Korea
1	2	3	4	5	6	7
1.	Legal	Laws and special commis-sion control	Laws and statutory documents	Laws and federal control	Laws and special regulatory legal documents	Laws and state control
2.	Organizatio-nal	Ministry, state and non-governmen-tal organiza-tions	Agency, ministry	Ministry of Foreign Affairs, Ministry of Economy and Energy	Ministry, council and various programs	State agency
3.	Financial	Eximbank	Export Credit Guarantee Department	Consortium of Private Banks AKA and KFW State Bank Group	Japan International Cooperation State Bank	Korea Trade and Investment Development Agency
4.	Administra-tive	Centrali-zed and private system	Centralized public administra-tion	Federal, regional level	Centralized public administra-tion	Central and regional
5.	Economical	development of consulting, financial instruments and individual marketing strategies	information-advisory, marketing, advertising services, as well as political-diplomatic support, special programs	Marketing, transportation subsidies, consulting	consulting and advertising services, lobbying	logistic support, image and brand promotion
6.	Territorial	Export assistance centers, Small Business Administration centers	Territorial divisions under the administration of the central government	Regional chambers of commerce and industry	Japan Foreign Trade Promotion Organization and its divisions	Representations of the State Agency
7.	Information and Internet resources	export.gov, business.USA.gov	exportingisgreat.gov.uk	ixpos.de	jetro.go.jp/en/	http://english.kotra.or.kr

The developed countries studied on the basis of research have the following organizational means of export support:

− information and advisory support (market and marketing research, legal advice, etc.);

---

[3] Developed by the author.

− educational and special information-educational events (seminars, webinars, etc.);

− organizing advertising, exhibitions and fairs, helping to establish business relations and cooperation with foreign partners;

− "trade-political support (improving access to foreign markets, eliminating discriminatory restrictions by ensuring effective use of WTO instruments, regional and bilateral agreements on free trade);

− political-diplomatic support (state visits, lobbying, support of investment projects and export deals, promotion of a positive business image);

− removal of excessive administrative barriers".

The mechanism of modern export support in developed countries is based on mutual cooperation of state and non-state institutions, including specialized ministries and agencies, specialized institutions and export centers, financial institutions, regional and foreign officials. In our opinion, the rich practical experience gained by these countries will serve as a program for every developing country at a time when globalization processes are rapidly deepening in the world economy (Table 1).

Table 2.

Organizational and economic mechanisms of export activity management

Management methods		Export policy implementation tools	Availability in practice
Organizational and economic	By tariffs	Customs duty	At zero rate
	Quantitative restrictions	Quota, licensing	For some products and activities
	Unrated — Hidden	Voluntary export restrictions	It is used by most developing countries when exporting their national products abroad under the pressure of importers to restrict exports.
	Financial	• Subsidies • Export credits • Anti-dumping	Yes Yes Yes
Organizational and legal	Creation of a system of national organizations supporting export	Promotion of national products abroad and search for new markets	"Uztreyd" JSC is a foreign trade company
	Improvement of regulatory and legal documents on further development of export activities	Adapting the existing ones to the requirements of the present time, accepting the necessary ones and putting them into practice	Law, decree, decision and other legal documents
	Development of activities of legal and information-advisory organizations for exporters	Provision of legal, information-consulting and marketing services	Export support agencies

Discussions. As can be seen from the table, developed countries use various mechanisms to support the export of industrial products. Most of these mechanisms are based on state support, and in national practice, the introduction of

foreign export centers, promotion of local brands, provision of various insurance products, development of industrial export development programs at the regional level, and effective can be used. At the same time, it is considered appropriate to implement the following:

- Organization of export development agencies and export centers;

- Development of export insurance system and activities of export credit agencies;

- searching for new export markets. For example, India, as the second most populous country, has a much larger market. The next destinations are Japan and South Korea. Although South Korea is considered a strategic trading partner for us, we still have a negative balance. Japan is a giant market that imports products worth about 600 billion dollars a year, and it is necessary to master the rules of the Japanese market.

Organizational and economic mechanisms of export activity, areas of application of management methods and tools, interdependence and connection between them are presented in Table 2.

As can be seen from the table, we can see that there are a number of problems and shortcomings in the organizational and economic mechanisms of export support.

Conclusion. It is possible to take a place in the ranks of the countries that

•

supply competitive products in the foreign market only by using the means of effective state support for export activities, as shown by the experience of developed countries. These tools require further improvement of the organizational and economic mechanisms used by the state. Regarding the improvement of the organizational and economic mechanisms of export activity, the following can be suggested:

• help exporters obtain international certificates and licenses that fully meet the requirements of world standards, including Global GAP, ISO and other documents;

• finding foreign partners for entrepreneurs and helping to sign export contracts by studying the demand of foreign countries for products and services;

• regular involvement of enterprises in export activities in the region and organization of meetings dedicated to the discussion of emerging problematic issues;

• to study sales channels of industrial products in the region;

• to propose the direction of improvement of the product and price policy in the industrial sector and the systems of promotion of product sales;

• it is necessary to carry out important studies that ensure the increase in the efficiency of product export in industrial enterprises.

References

[1] Ilyosov, A. (2020). Some problems in digital production and export of industrial products in the digital economy// *Economics and finance.* 2020. №3. 175-182 p. ISSN 2010-9997

[2] Kurpayanidi, K. I., & Ilyosov, A. A. (2020). Problems of the use of digital technologies in industry in the context of increasing the export potential of the country. *ISJ Theoretical & Applied Science,* 10 (90), 113-117. Doi: https://dx.doi.org/10.15863/TAS

[3] Kurpayanidi, K. et al. (2020). The issue of a competitive national innovative system formation in Uzbekistan. *E3S Web of Conferences*. – EDP Sciences, 2020. – T. 159. – C. 04024. DOI: https://doi.org/10.1051/e3sconf/202015904024

[4] Kurpayanidi K., Ilyosov A. (2020) Problems of the use of digital technologies in industry in the context of increasing the export potential of the country// *International Scientific Journal Theoretical & Applied Science.* p. 113-117.

[5] Abdullayev, A. M., & Kurpayanidi, K. I. (2020) Analysis of industrial enterprise management systems: essence, methodology and problems. *Journal of Critical Reviews*, 7 (14), 1254-1260. https://dx.doi.org/10.17605/OSF.IO/E6JFS.

[6] Ilyosov, A. (2021). Prospects for the use of mechanisms based on the cluster approach in the development of exports of industrial products. *Electronic journal of actual problems of modern science, education and training*, 67-78.

[7] Ilyosov, A. A. (2020). Industrial and regional analysis of industrial production and export in Uzbekistan. *EPRA International Journal of Research and Development* (IJRD), 5(10), 173-179.

[8] Ilyosov, A. A. (2022). Sanoat mahsulotlari eksporti: hududiy tahlil, omillar va eksportdagi tendentsiyalar (Farg'ona viloyati misolida). *Nazariy va amaliy tadqiqotlar xalqaro jurnali*, 2 (1), 31-40. doi: 10.5281/zenodo.6089956.

[9] Kurpayanidi, K. I., & Ilyosov, A. A. (2020). Koronavirus pandemiyasining jahon va hududiy sanoat mahsulotlari eksportiga ta'siri: muammo va takliflar. "Yangi O'zbekiston iqtisodiyotining makroiqtisodiy barqarorligini taminlash: muammolar, tahlillar va natijalar" mavzusida Respublika miqyosida onlayn, ilmiy masofaviy konferentsiya materiallari.

[10] Курпаяниди, К. И., & Илёсов, А. А. (2022). Саноат маҳсулотлари экспортининг ташкилий-иқтисодий механизмларини такомиллаштириш (Фарғона вилояти саноат тармоғи мисолида)// Монография. Al-Ferganus, 2022. ISBN 978-9943-7707-5-1. – DOI: https://doi.org/10.5281/zenodo.6618980

[11] Усманова, З. М. (2022). К актуальным вопросам использования технологии кайдзен в совершенствовании механизма управления персоналом на предприятиях лёгкой промышленности. *Nazariy va amaliy tadqiqotlar xalqaro jurnali, 2(1), 108*-116.

[12] Усманова, З. М. (2021). К вопросам совершенствования подходов механизма управления персоналом на предприятиях лёгкой промышленности. In наука сегодня: теория и практика (pp. 18-20).

[13] Usmanova, Z. (2020). Blockchain technology as a basic factor of digital economy цифровой экономики. Scientific Bulletin of Namangan State University, 2(4), 174-179.

[14] Усманова, З. М. (2020). Вопросы инвестирования свободных экономических зон в регионах. In минтақа иқтисодиётини инвестициялашнинг молиявий-ҳуқуқий ва инновацион жиҳатлари (pp. 399-404).

[15] Илёсов, А.А. (2022). Саноат маҳсулотлари экспортини давлат томонидан қўллаб-қувватлашнинг Германия тажрибаси. *Nazariy va amaliy tadqiqotlar xalqaro jurnali, 2 (9),* 46-56. Doi:https://dx.doi.org/10.5281/zenodo.7187496

[16] Ilyosov, A.A. (2022). Sanoat eksporti klasterlarini rivojlantirish istiqbollari. *Nazariy va amaliy tadqiqotlar xalqaro jurnali,* 2 (2), 23-30. https://dx.doi.org/10.5281/zenodo.6466280

[17] Kurpayanidi, K. I. , Mamurov, D.E.(2022). Management of innovative activities of business entities in industry: AL-FERGANUS, 200 p.

[18] Tsoy, D., Godinic, D., Tong, Q., Obrenovic, B., Khudaykulov, A., & Kurpayanidi, K. (2022). Impact of Social Media, Extended Parallel Process Model (EPPM) on the Intention to Stay at Home during the COVID-19 Pandemic. *Sustainability*, *14*(12), 7192.

[19] Kurpayanidi, K. (2021). National innovation system as a key factor in the sustainable development of the economy of Uzbekistan. In *E3S Web of Conferences* (Vol. 258, p. 05026). EDP Sciences.

[20] Kurpayanidi, K. I. (2020). To issues of development of entrepreneurship in the regions: theory and practice of Uzbekistan (on the materials of Andizhan region). *ISJ Theoretical & Applied Science*, *6*(86), 1-10.

UDC: 336:658(575.1)

THE IMPORTANCE OF MULTIPLIER INDICATORS IN ASSESSING THE EFFECTIVENESS OF THE CASH FLOW OF THE ENTERPRISE

FOZILJONOV IBROKHIMJON

PhD of Tashkent State University of Economics
E-mail.: ifoziljonov@tsue.uz, phone.: (+99890) 622-80-08

Abstract:

Objective. This article discusses how you can improve your multiprocessor skills. In addition, the scientific basis for determining the financial status of Joint-Stock Companies in our country and their optimal levels based on macroeconomic indicators is given to the multiplier indicators that assess the effectiveness of the cash flow of enterprises.

Methods. The multiplicator indicators assessing the effectiveness of cash flows of joint-stock companies were calculated using the calculation of the solvency coefficient, the coefficient of maturity of funds received from their current activities to fulfill obligations, the Bivera coefficient, the coefficient of compensation of short-term liabilities from net profit, and the coefficient of adequacy of net cash flows.

Results. According to the results of our research, the normative norm of the bivera coefficient is 0.17-0.4. If the value of the coefficient is in the specified range, the joint-stock company is considered financially stable. If the value of the coefficient is in the range of -0.15 to 0.17, it indicates that the bankruptcy of the joint-stock company is five years away. If the value of the coefficient is less than -0.17, it indicates that the joint-stock company has one year left for bankruptcy. In our analysis, the Bivera coefficient of "Andijan regional power grid enterprise" JSC shows 0.20 in 2021. On the other hand, "Andijan regional power grid enterprise" JSC indicates the stability of the financial situation.

Conclusion. It can be said that the assessment of the effectiveness of the company's net cash flows through a direct method of determining the cash flows of Joint-Stock Companies provides an opportunity to assess the effectiveness of the cash flows of a Joint-Stock Company, determine the solvency, the adequacy of net cash flows to finance investment activities.

Keywords: cash flow, direct and indirect method, assessment of cash flow, optimal level of multiplier indicators, solvency coefficient, Bivera coefficient.

Introduction. There are direct and indirect methods for analyzing cash flows. In the method of analysis of direct cash flows, joint-stock companies consist in considering the information of funds that are positive and negative, formed by investing money in a business. This method shows the cash flow associated with the entry and exit of capital into a joint-stock company. Also, the cash of society in terms of economic activity is grouped. As a result, information is formed indicating net cash flows for the reporting period. In the management of cash flows of Joint-Stock Companies, great attention should be paid to the positive and negative cash flows from the main activities of the company, cash flows from its financial activities and cash flows from investment activities.

In general, the method of direct analysis of cash flows allows you to determine the input and output of cash flows, as well as to assess the availability of sufficient funds to pay current liabilities and the possibility of additional funds for investment. It is not necessary to have a net cash flow to keep the activities of the community positive. However, investment activity is characterized by a negative cash flow, the reason is the attraction of large investments in long-term assets and the expansion of the production of Joint-Stock Companies. But the current and financial cash flows of Joint-Stock Companies should be positive. In turn, it testifies to the positivity of society's activities, as well as the further development of society's activities. In particular, in order to assess the net cash flows of Joint-Stock Companies by direct means, it is necessary to calculate the effectiveness of the cash flows of the company.

Methods. The multiplicator indicators assessing the effectiveness of cash flows of joint-stock companies were calculated using the calculation of the solvency

243

coefficient, the coefficient of maturity of funds received from their current activities to fulfill obligations, the Bivera coefficient, the coefficient of compensation of short-term liabilities from net profit, and the coefficient of adequacy of net cash flows using the following formulas.

1. Coefficient of solvency of a joint-stock company:

$$C_s = (CF_{b.y} + CF_{inflow}) : CF_{ouflow}$$

Here:

$CF_{b.y}$ – cash flow at the beginning of the year;

CF_{inflow} – cash inflows in the reporting period;

CF_{ouflow} – cash outflows in the reporting period.

The normative values of the solvency coefficient are considered to be the range of 0,5 – 0,7. This value indicates the stability of the financial condition of the Joint-Stock Company. If the value of the coefficient is lower than the indicated range, it is understood that it is necessary to provide funds to joint-stock companies from external sources. If the value of the coefficient exceeds one, it indicates the presence of the solvency of society.

2. To fulfill the obligations of Joint-Stock Companies, the coefficient of adequacy of funds received from their current activities is determined as follows:

$$C_{a.f} = \frac{NCF_{current}}{F_f}$$

Here:

$NCF_{current}$ – net cash flow from current activities;

F_f – funds in financial activities.

The main drawback of direct cash flow analysis is the inability to indicate the relationship between the financial result of the Joint-Stock Company and the change in its capital. Also, this method of assessing cash flow was considered a more time-consuming method than other methods.

In particular, the method of direct cash flow analysis allows you to calculate the net cash flows of the reporting period using the data of financial results and balance sheet reports. The method of direct cash flow analysis shows how sufficient the internal sources of financing the activities of a Joint-Stock Company are. It also provides an opportunity to timely identify negative trends in the functioning of society and develop timely measures to prevent their negative consequences.

3. An indirect method of assessing the net cash flow of Joint-Stock Companies is also majud, and the following coefficients are used in this method. One of these coefficients is the Bivera coefficient:

$$C_{Biv} = \frac{NP+D}{LTL+SHTL}$$

Here:

NP – net profit in the reporting period;

D – the amount of depreciation in the reporting period;

$\overline{LTL}$ – average amount of long-term liabilities;

$\overline{SHTL}$ – average amount of short-term liabilities.

The normative norm of the Bivera coefficient is 0.4-0.47. This coefficient indicates the relationship between the net profit of a Joint-Stock Company and liabilities.

4. The coefficient of compensation for short-term liabilities of joint-stock companies from net profit is expressed by the following formula:

$$C_{com} = \frac{NP+D}{SHTL}$$

Here:

NP – net profit in the reporting period;

D – the amount of depreciation in the reporting period;

$\overline{SHTL}$ – average amount of short-term liabilities.

5. In addition, in practice, generalized indicators are used in the analysis of cash flows of Joint-Stock Companies. In particular, the formula for the coefficient of adequacy of net cash flows is expressed as follows:

$$C_{NCF} = \frac{NSF}{LSHL + \varDelta CM + Д}$$

Here:

NCF – net cash flow in the reporting period;

LSHL – payment for long and short-term liabilities in the reporting period;

$\varDelta CM$ – changes in commodity and material reserves in the reporting period;

D – dividend payments of a joint-stock company for the reporting period.

If this coefficient is $C_{NCF} \geq 1$, it means that the joint-stock company has sufficient sources of funds to finance its activities. If this coefficient is $C_{NCF} < 1$, it indicates that joint-stock companies have insufficient funds to finance their activities. This leads to financing the activities of the joint-stock company from external sources.

Also, the efficiency coefficient of cash flows is reflected in the following formula:

$$C_{ECF} = \frac{NFC}{CF_{outflow}}$$

Here:

NFC – net cash flow in the reporting period;

$CF_{outflow}$ – cash outflow in the reporting period.

Results. The coefficient of solvency, the coefficient of sufficiency of funds received from current activities to fulfill obligations, the coefficient of liquidity, Bivera coefficient, the coefficient of coverage of short-term liabilities from net profit and the coefficients of adequacy of net cash flows of the joint-stock company "Andijan Regional Power Grid Enterprise" operating in our country are multiplier indicators that evaluate the effectiveness of cash flows. We will perform the analysis using financial indicators from 2017 to 2021.

Dynamics of cash flows of JSC "Andijan Regional Electric Networks Enterprise", bln. in sum [6]

Indicators	2017 y.	2018 y.	2019 y.	2020 y.	2021y.
Net cash flow input/output from operating activities	58,8	73,0	55,5	43,00	76,2
Net cash flow input/output from investment activities	(16,4)	-	-	-	62,7
Net cash inflows/outflows from financing activities	(1,0)	0,1	(1,0)	(1,90)	(51,9)
Total taxes paid	41,4	70,3	57,5	41,10	18,1
Net cash flow inflow/outflow of financial activities	-	2,8	(3,0)	0,05	68,9
Funds at the beginning of the year	0,2	0,2	3,0	0,02	0,1
Year-end cash	0,2	3,0	0,02	0,07	69,0

Table analysis shows that the cash flow of the Andijan regional power grid enterprise JSC at the end of 2017 0.2 billion. we can see an increase of almost 345 times in 2021, when the sum was up. The main reason for this is the entry of net cash flows from operating activities in 2017 to 58.8 billion. having reached the sum, in

2021 it was 76.2 billion. it was at the expense of increased sums.

In the analysis of net cash flows from the investment activities of the Joint-Stock Company, the output of net cash flows from investment activities in 2017 amounted to 16.4 billion. while the sum was negative, by 2021 it was 62.7 billion. Som Net cash flow carried out in the credited.

It can be seen from this that the proceeds from the sale of long-term and short-term investments indicate a sharp increase. And in 2017, 16.4 billion. som indicates that the main tool was purchased. And in 2021, 62.7 billion. som sold long-term and short-term investments. 1.0 billion in 2017. the net cash flow output from the financial activities of the sum was 51.9 billion in 2021. the fact that there was an outflow of net cash from the financial activities of the sum led to the fact that the flow of money from financial activities was negative. The reason is that in 2017, payments on long and short-term loans and debts amounted to 0.7 billion. fees for sum and long-term rent (leasing) are 0.1 billion. formed som. And in 2021, when buying private shares and selling them, cash

payments 35.8 billion. it can be explained by the fact that there was a sum.

If we analyze the taxes paid by the joint-stock company, 41.4 billion in 2017. amounted to 18.1 billion soums in 2021. However, we can see that the net cash flow of the joint-stock company's financial and economic activity will be negative mainly due to the high volume of paid taxes. In particular, the taxes paid in 2018 amounted to 70.3 billion. reaching 57.5 billion soums in 2019. is the reason for the formation of soum. In turn, it indicates that the tax burden of the joint-stock company is high.

Analysis of net cash flows from operations, investment and financial activities of JSC" Andijan regional power grid Enterprise " shows that the output of cash flows from investment and financial activities to a decrease in the net cash flow of society is increased from year to year. Also, the volume of taxes paid leads to an increase in the net cash output of financial and economic activities.

We can see in Table 2 the analysis of indicators that assess the net monetary efficiency of Andijan regional power grid enterprise based on the cash flows.

Table 2

Analysis of indicators assessing the net monetary efficiency of JSC" Andijan regional power grid enterprise"

Indicators	2017 y.	2018 y.	2019 y.	2020 y.	2021y.
C_s	1,93	1,0	0,02	0,04	1,32
$C_{a.f}$	0,16	5,87	0,02	0,04	1,32
Bivera coefficient	0,17	0,19	0,28	0,23	0,20
C_{com}	45,03	195,98	235,33	1,31	0,85
C_{NCF}	0,3	0,3	0,0	-	2,1

According to the results of our research, the standard values of the solvency ratio should be Cs≥0.4. Our analysis shows that the normal value of the solvency ratio is greater than one. This, in turn, indicates that "Andijan Regional Electric Networks Enterprise" JSC has a high solvency and sufficient funds to develop its activities.

It shows that the coefficient of net cash sufficiency to fulfill the obligations of the joint-stock company $C_{a.f}$ was 0.16 points in 2017, and increased to 1.32 points in 2021. A greater than one ratio of this ratio indicates the company's ability to meet its financial obligations with net cash flow from operating activities, in particular, to pay interest payments related to financial

activities without attracting money from external sources. In particular, it can be seen from the analysis of JSC "Andijan Territorial Power Networks Enterprise" that the ratio of net cash to fulfill the obligations of the joint-stock company in the last year is higher than one. Also Bivera coefficient is 0.17 in 2017 and 0.20 in 2021.

According to the results of our research, the normative norm of the bivera coefficient is 0.17-0.4. If the value of the coefficient is in the specified range, the joint-stock company is considered financially stable. If the value of the coefficient is in the range of -0.15 to 0.17, it indicates that the bankruptcy of the joint-stock company is five years away. If the value of the coefficient is less than -0.17, it indicates that the joint-stock company has one year left for bankruptcy. In our analysis, the Bivera coefficient of "Andijan regional power grid enterprise" JSC shows 0.20 in 2021. On the other hand, "Andijan regional power grid enterprise" JSC indicates the stability of the financial situation.

It shows that the ratio of net profit coverage of short-term liabilities (C_{com}) was 45.03 points in 2017, and it was 0.85 in 2021. If this coefficient is $C_{com} \geq 1$, it means that the joint-stock company has sufficient sources of funds to finance its activities. If this coefficient is $C_{com} \geq 1$, it indicates that joint-stock companies do not have enough funds to finance their activities. This leads to financing the activities of the joint-stock company from external sources.

The net profit of a joint-stock company indicates the ability to cover almost 85% of short-term liabilities. We can see that the coefficient of net cash flow adequacy (C_{NCF}) rose to 2.1 points in 2021, while in 2017 it was 0.3 points. The normative value of this coefficient should be greater than one. In particular, this coefficient indicates to what extent the net cash flow of a joint-stock company covers long-term and short-term liabilities. In conclusion, the "Andijan regional power grid enterprise" is explained by the fact that

the solvency of the AJ has increased in recent years and net cash flows have increased through it. An analysis of society in the course of years shows that in recent years, efficiency indicators have a tendency to rise.

Discussion. The main direction in increasing the efficiency of cash flow management of Joint – Stock Companies is the introduction of modern methods and forms of planning and forecasting cash flows. At this point, the main task of managing cash flows will be to ensure that funds are balanced by type, volume, time intervals, and other important details.

Foreign Economist scientists in the study of Dechow, Kothari and Watts noted that when forecasting cash flow, it is necessary to attach importance to forecasting the future cash flow of current profit. In their eyes, the current profit is calculated equal to the cash flow, which includes changes in the creditor's Karz, changes in the receivables, changes in commodity and material reserves, changes in depreciation depreciation depreciation depreciation and others. Also, the calculations include only changes in receivables, changes in commodity and material reserves and changes in accounts payable, which, in turn, are equivalent to changes in working capital, but long-term calculations such as depreciation are not taken into account [1].

In particular, other foreign Economist scientists divided the components of cash flow into the main and non-main ones. As a result, analyzed their stability to determine future cash flows. The study identified the following as the main components of cash flow: sales, cost of goods sold, operational and administrative costs. The main non-cash flow components took into account interest, taxes, etc [2].

In addition, in the research of Orport and rust, they studied whether it is important to use the elements disclosed in the report on direct cash flows by evaluating the components of monetary funds in an indirect way. They forecast

models study the statistical significance of errors, finding that there is an error between the calculated Monetary elements and the data revealed in their regression model. Their results show that the coefficients of the terms of the error have statistical significance, and therefore articulation errors have additional data for Predicting Cash Flows. This implies that the direct cash flow method provides more information in predicting future cash flows than the indirect cash flow method [3].

In recent years, scientists from foreign economists have conducted research on the factors affecting the forecasting of cash flows. The increase in voluntary payments and operational costs in the management of income in joint-stock companies affects the forecasting of cash flows. According to the Badersher study, financial managers of a joint-stock company use voluntary calculations to hide the real position of society as a management tool to maintain capital value. Also, manipulative reports used as information reduce their ability to predict cash flows. In addition, managers can use voluntary calculations to demonstrate their true vision of the future of a joint-stock company. In this situation, the management's reports on voluntary payments make it possible to better predict future cash flows. As a result, voluntary settlements are considered to improve the forecast of cash flow or have a negative impact on the motivation for manipulating financial managers [4].

One of the founders of the St. Elmirzaev Masonic Lodge noted that, in his opinion, "the emphasis is on making a forecast for the future pool of shares that may lead to a fall in the ruble exchange rate." Thus, shareholders can expect that their share will increase in the medium term and predict a shortage of funds. Thus, based on the concept of pool allocation, it can be assumed that the pool will consist of shares in free circulation and assets in free circulation [5].

In our opinion, when forecasting the cash flow of joint-stock companies, it is necessary to make a clear prediction of the proceeds of companies from the sale of products. Also, the cost structure should take into account changes in the calculated accounts payable, changes in receivables, changes in commodity and material reserves depreciation.

Conclusions. To assess the net cash flows of Joint-Stock Companies in developed countries through a direct method, the coefficients of the efficiency of cash flows of societyare widely used.

In conclusion, it can be said that the assessment of the effectiveness of the company's net cash flows through a direct method of determining the cash flows of Joint-Stock Companies provides an opportunity to assess the effectiveness of the cash flows of a Joint-Stock Company, determine the solvency, the adequacy of net cash flows to finance investment activities.

References

1. Dechow P., Kothari S., Watts R.L. 1998. The relation between earnings and cash flows. J. Account. Econ. 25, 133–168.

2. Cheng C., Hollie D., 2008. Do core and non-core cash flows from operations persist differentially in predicting future cash flows? Rev. Quant. Finance Account. 31, 29-53.

3. Orpurt S., Zang Y., 2009. Do direct cash flow disclosures help predict future operating cash flows and earnings? Account. Rev. 84, 893-935.

4. Badertscher B.A., Phillips J.D., Pincus M., Rego S.O. 2009. Earnings management strategies and the trade-off between tax benefits and detection risk: to conform or not to conform? Account. Rev. 84, 63-97.

5. Elmirzayev S. Korporativ moliya. Darslik. – T.: Iqtisod-Moliya, 2019, 371 b.

6. Cash flow accounts of the Joint-Stock Company "Andijan regional power grid enterprise".

7. Luehrman, T. A. (1998, July). Investment Opportunities as Real Options. Harvard Business Review , 51-67.

8. Chen, Mark T,P.E., C.C.E. 2007, "ABC of Cash Flow Projections", AACE International Transactions, pp. PM21-PM25.

9. Yun Li, Luiz Moutinho, Kwaku K. Opong, Yang Pang. 2014 "Cash flow forecast for South African firms" Review of Development Finance, Volume 5, Issue 1, June 2015, Pages 24-33.

10. Jury, T. 2012, Wiley Finance: Cash Flow Analysis and Forecasting: The Definitive Guide to Understanding and Using Published Cash Flow Data (2nd Edition), John Wiley & Sons, Hoboken, NJ, USA. Available from: ProQuest ebrary.

11. Rajendra, R 2013, Handbook of Global Corporate Treasury, John Wiley & Sons, Somerset, NJ, USA. Available from: ProQuest ebrary.

12. Bragg, SM 2010, Treasury Management: The Practitioner's Guide, John Wiley & Sons, Hoboken, NJ, USA. Available from: ProQuest ebrary.

13. Phillips J.F. (2003). The Dilemma of Valuing Not-for-Profit Hospitals-Is Free Cash Flow the Answer? Journal of Accounting and Public Policy, 22, (4), 347-374.

14. Freund S., Prizes A. & Vasudevan G. (2003). Operating Performance and Free Cash Flow of Asset Buyers. Financial Management, 32, (4), 87-106.

15. Qurbonov Kh. Corporate Finance. – T.: Economy and finance, 2007, 40 pg.

16. Elmirzayev S. and others. Financial market. Textbook. – T.: "Economy and finance", 2019. – 324 pg.

17. Toshmuradova B.E., Elmirzayev S. E., Tursunova N. R. Financial management. Textbook. – T.: TFI, 2017, 140 pg.

18. Burkhonov A. U. And Khamdamov O. N. Financial management. Textbook. -T.: "Innovative development" publishing house, 2020, 240-241 pg.

19. Bhojraj S., Lee, C.M.C., 2002. Who Is My Peer? A Valuation Based Approach to the Selection of Comparable Firms. Journal of Accounting Research 40, 407-439.

20. Dirk Brounen, Abe de Jong and Kees Koedijk (2004) "Corporate Finance In Europe Confronting Theory With Practice", erim report series research in management, 1-44.

UDC 338.23

INNOVATIVE ACTIVITY OF BUSINESS ENTITIES IN THE CONDITIONS OF TRANSFORMATION: A RETROSPECTIVE ANALYSIS

KURPAYANIDI KONSTANTIN

Professor of Fergana polytechnic institute
E-mail: antinari@gmail.com, phone.: (+99897) 100-38-88

Abstract:

Objective. To conduct a theoretical analysis of the categories "innovation" and "innovative activity". To prove, from the standpoint of historical dialectics, that innovation is an endogenous source of economic growth.

Methods. The study used a systematic approach, retrospective analysis, abstract-logical analysis, grouping, comparison, factor analysis.

Results. In the current conditions of instability of the world economy, the issue of its further development, including from a technological point of view, is relevant. In historical retrospect, the emergence of technological innovations on the market had a positive impact on the process considered in the study. The recognition of innovation as an endogenous source of economic growth is due to the nature of the post-industrial economic structure, characterized by the decline in the role of traditional factors of

production in the formation of competitive advantages of individual producers, as well as the formation of a qualitatively new type of progressive macroeconomic dynamics. In these conditions, the innovative activity of business entities becomes particularly relevant. The article considers various approaches of scientists and representatives of various economic schools to the definition of the concepts of "innovation" and "innovative activity".

Conclusion. Based on a retrospective analysis of a number of scientific papers devoted to innovation, it is concluded that in order to ensure the successful and dynamic development of an enterprise producing high-tech products, it is necessary first of all to widely apply various methods of innovation management, which should include simultaneous and coordinated use of technological, scientific, personnel, commercial and other policies that provide a systematic solution to the problems of innovative development.

Keywords: analysis, innovation, innovative activity, innovative economy, R&D, transformation of the economy.

Introduction. The analysis of modern processes that take place in the world economy and the economy of the Republic of Uzbekistan indicates that the results of innovative activities initiated by the acceleration of scientific and technological progress significantly affect all aspects of the development of society, contribute to the way out of a difficult economic situation, ensure the stability of economic development, give a new impetus to economic growth [1]. In this regard, the innovative model of the development of economic systems is extremely attractive and the most acceptable for the national economy of Uzbekistan, this is especially relevant in the current crisis situation of the world economy.

Based on the theory of long-term cycles of development of the modern world economy, known as Kondratiev's long waves [2], the way out of the economic crisis and a new economic recovery begin with a key innovation, giving rise to a number of derivative innovations in other industries. Thus, an increase in innovation activity is a necessary condition for the start of recovery growth.

Transformation and globalization of the world economy, increasing volatility of prices for natural resources and energy resources are becoming a key factor in the development of socio-economic structures, which is due to their focus on modernization and fundamental innovations. Intensive development and application of innovative solutions allow companies to produce competitive products and strengthen their position, as well as occupy new niches in global and local markets. The development of innovative infrastructure can bring significant advantages to a company in a competitive environment, which determines global trends in the development of companies around the world.

Methods. The study used a systematic approach, retrospective analysis, abstract-logical analysis, grouping, comparison, factor analysis.

Analysis and results. In order to determine the directions and explore the possibilities of improving the innovation management systems of enterprises, it is necessary to analyze the existing theoretical developments of leading scientists concerning innovation and its management.

Many economists at different times have tried to define and reveal the essence of innovation activity. The issues of defining innovation activity have been considered by many prominent figures of economic science. Among them are J. Schumpeter [3], B. Twiss [4], B. Santo[5], K. Christensen [6], M. Raynor [7], J.J. Lambin [8], G. Mensch [9], S. Kuznets [10], P. Drucker [11], M. Porter [12], Y.V. Yakovets [13], A.I. Prigozhin [14], E.A. Utkin [15], Z.P. Rumyantseva [16], I.T. Balabanov [17], S.D. Ilyenkova [18], N.A. Solomatina [19], A.N. Tsvetkov [20], P.N., N.D. Kondratiev [21], A.V. Vasiliev [22], A.N. Tyurina [23], I.L. Tukkel [24] and others.

The founder of the theory of innovation is considered to be J. Schumpeter, who associated innovation activity primarily with entrepreneurship, i.e. with "the desire to manufacture a new or improve a product, a method of production, introduce a new technology or master new sales markets, get new sources and new forms of supply, as well as optimize production and labor processes" [25].

P. Drucker defines it as follows: "innovative activity is a special tool that allows an entrepreneur to use changes and turn them into new opportunities for, for example, opening a new business or providing new services" [26]. He calls the main principles of successful activity "purposefulness and systematic innovation", emphasizing the importance of "analyzing existing opportunities and thinking about what can be called sources of innovative opportunities" [27]. p. Drucker emphasizes that "innovation is an economic rather than a technological term and covers all the components of an enterprise, all its functions and activities" [28].

B. Twiss includes the following areas in the interpretation of innovation activity - "technical, production and marketing activities aimed at the commercial use of a new (or improved) product or the first commercial use of a new (or improved) production process or equipment." Noting the need for the permanence of this activity of enterprises, the researcher defines its purpose as "the acquisition of economic content by an invention or idea" [29].

To. Christensen and M. Raynor give the following definition: "innovative activity of an enterprise is an activity aimed at using the results of scientific research and development to update the nomenclature and improve the quality of products, improve the technology of its manufacture" [30]. The authors distinguish two types of innovations: "supportive" and "disruptive". The "supportive" innovation activity is aimed at improving existing products within the current consumer characteristics, while the "disruptive" one is aimed at replacing existing products, technologies, industries and markets by creating "easy-to-use, cheap and not of high quality" new versions of products [31].

B. Santo gives the following definition: "innovation is a socio–economic process that, through the practical use of ideas and inventions, leads to the creation of products and technologies that are the best in their properties, and if innovation is focused on economic benefit (profit), its appearance on the market can bring additional income" [32], thereby determining that the purpose of innovation activity can be not only profit, but also public goods.

G. Mensch proposed to link the nature and intensity of innovation activity with the pace and cycles of economic growth, distinguishing three main types of innovations: "basic, improving and pseudo-innovations" [33]. The author considered the deterioration of the financial situation of the enterprise to be the key driver of the activation of innovation activity, and defined innovation as a key tool for improving the efficiency of investments and overcoming stagnation in economic development, which he defined as "technological stalemate" [34].

R.A. Fatkhutdinov defines innovation activity as "the process of strategic marketing, R&D, organizational and technological preparation of production, production and design of innovations, their implementation (or transformation into innovation) and dissemination to other areas (diffusion)" [35]. According to the author, "innovative activity is primarily characterized by the content, composition of specific actions performed according to a certain technology, procedure."

I.L. Tukkel, together with A.V. Surina and N.B. Kultin, define innovative activity as "activity aimed at using the results of experimental developments, scientific (research) and scientific-technical, inventive activity: for the creation, organization of production and sale on the market of fundamentally new or with new

consumer properties products (goods, works, services); creation and application of new or modernization of existing methods (technologies) of its production, distribution and use; the use of product, process, marketing, organizational innovations (innovations) in the development, organization of production, release and sale of products (goods, works, services) that provide them with cost savings, or an increase in production and sales of products in demand on the market" [36]. The authors distinguish product, process, marketing and organizational directions of innovation activity, defining "innovative programs and projects, innovative products" as objects of innovation activity [37].

L. N. Ogoleva presents innovative activity as a "purposeful system of measures for the development, implementation, development, production, diffusion and commercialization of innovations", thereby emphasizing its consistency, complexity, multivariance and alternativeness. The author defines the boundaries of innovation activity "from the birth of a scientific idea to its commercialization" [38].

F.F. Bezdudny, together with G.A. Smirnova and O.D. Nechaeva, associate the concepts of "innovation" and "innovative activity" with "the process of implementing a new idea in any sphere of human activity that contributes to meeting existing needs in the market and brings economic effect" [39], noting that innovation can only have "a positive result, excluding the possibility of negative consequences, otherwise the innovation will not make sense."

N. M. Tsitsarova defines innovation activity as "a set of works including the search and selection of innovative ideas, the development of innovations based on them, the introduction and replication of innovations" [40]. The author notes the "diversity of organizational forms" involved in innovation activities, linking this to the fact that "the process of innovation covers a variety of fields of activity: scientific and technical, financial, informational, marketing, and various interacting organizations participate in its implementation: research institutes, financial and consulting organizations, venture firms, insurance companies" [41].

I.T. Balabanov defines innovation activity as "a process aimed at developing and implementing the results of completed scientific research and development or other scientific and technical achievements into a new or improved product sold on the market, into a new or improved technological process used in practice, as well as related additional research and development", including in this term all stages "from the emergence of the idea of innovation to the diffusion of the final product or service"[42].

In their work, A.G. Kiryakov and V.A. Maksimov emphasize the social significance of innovation, offering the following definition: "innovation activity is a socio—technical and economic process that, through the practical use of ideas and inventions, leads to the creation of products and technologies that are the best in their properties" [43]. Innovation is assigned the role of "the starting and defining organizational and economic element in the investment process, which forms the system of indicators of the investment project and its ultimate goal."

L.N. Vasilyeva, E.A. Muravyeva believe that "innovation is the final, materialized result of innovation activity obtained from investing capital in discovery, invention, a new method of meeting social needs" [44], thereby defining the project approach as the basis of innovation activity, as well as emphasizing the social and investment orientation of the results innovation activity.

I. Ya. Luzhinsky and M. P. Pereverzev interpret the term "innovation activity" as "an integrated concept that combines scientific and technical and investment activities." At the same time, the authors note that when considering the

concept of innovation activity, the idea of "a special type of activity that covers the entire cycle of creation and use of new technologies and goods" comes to the fore, which defines it as "the main factor in the system of factors ensuring the development and improvement of production efficiency" [45].

N. N. Khanchuk in his article gives an idea of innovation activity as a "complex categorical structure" [46] and identifies the following categories of innovation activity: historical, economic, instrumental, philosophical, legal, commercial, entrepreneurial, economic, organizational and managerial, thereby further expanding the boundaries of innovation activity.

Having a common semantic similarity, the interpretations of the concept of "innovation activity" among various scientists also have differences concerning, for the most part, the definition of the boundaries of innovation activity, that is, indications of where innovation activity begins and ends.

A more precise formulation of the concept of "innovative activity" is presented in Russian and international regulatory documents.

Currently, a number of guidelines have been developed under the auspices of the Organization for Economic Cooperation and Development (OECD) in order to solve the problems of obtaining and analyzing data related to science, technology and innovation. According to Frascati's Guidelines, innovation is defined as "the final result of innovative activity, embodied in the form of a new or improved product introduced on the market, a new or improved technological process used in practice, or in a new approach to social services" [47].

According to the Oslo Manual, innovation activity means "any scientific, organizational, technological, commercial and financial actions that actually lead to the implementation of innovations or are conceived for this purpose" [48]. At the same time, the manual clarifies that "innovative activity also includes research and development not directly related to the preparation of any particular innovation" [49]. The authors of the Manual distinguish four types of innovations: product, process, marketing and organizational.

Stating the fact that neither science, nor international organizations and the state have adopted a single interpretation of the term "innovation activity", the definitions presented above are used in practice and by complementing each other sufficiently fully reveal the essence and meaning of innovation activity in the modern world. The theoretical works described above explore the origins and nature of innovation processes, fundamental problems of scientific, technical and innovation management.

Thus, the term "innovative activity" of the enterprise in this paper will mean the activity of the enterprise aimed at creating and implementing innovations in order to improve the socio-economic situation of the enterprise, namely, the emergence of new and improving the properties of existing products and services, technological lines, enterprise management systems, production and sale of products and services, improving safety and environmental friendliness of production. The concept of "innovation process" denotes an ordered set of actions that transform an innovative idea into a final result (the emergence of new and improving the properties of existing products and services, technological lines, enterprise management systems, production and sale of products and services, improving the safety and environmental friendliness of production). According to the accepted definitions, the innovative activity of an enterprise consists of innovative processes. The peculiarity of innovation activity is the focus on obtaining the final result, which has certain characteristics. Therefore, the main form of innovation activity is currently an innovative project, within the framework of which the specified values of target indicators should

be achieved based on the use of a certain set of resources and tools in a given time.

Currently, innovation activity is an integral part of the socio-economic development of industries and states, therefore, issues related to the management of innovation activities come to the fore.

In his work, G. Wulfen [50] defined the FORTH method (the abbreviation stands for: Full Steam Ahead ("Full Steam Ahead!"), Observe & Learn ("Observations and Conclusions"), Raise Ideas ("Development of ideas"), Test Ideas ("Testing ideas") and Homecoming ("Returning home")), which offers a clear sequence of actions for each stage of the innovation process, and also, according to the author, includes all the necessary tools for the effective creation of new products and services. The work of this author is more of a psychological orientation and is aimed at the personal growth of innovators, rather than at the creation of specific mechanisms.

G. Pisano defines the main problem of innovation management as the inconsistency between innovation strategies and other activities in the company, the difficulty of determining priorities between innovative projects for their financing. As a possible solution to these problems, he suggests the development of tools of the following functionality: "ensuring consistency and interconnectedness between innovation strategy, processes, organizational structures and procedures for the allocation of financial resources; formulation of clear goals of the company aimed at ensuring sustainable competitive advantages; development of value creation plans; introduction of parallel procedures for the selection and implementation of various types of innovations; finding a balance between different innovation strategies" [51].

R. Foster and S. Kaplan call the main problem of innovation activity "dependence on the behavior of the external environment, offering to solve it for by changing the approach to strategic planning and taking into account alternative ways of obtaining innovations" [52].

According to the point of view of V.P. Barancheev, N.P. Maslennikova and V.M. Mishin, the peculiarity of innovation management is that "the object of management is the life cycle of an innovation or an innovative product that arises on the basis of previous knowledge of highly qualified specialists concentrated in one place, and design is carried out by creating new knowledge and this knowledge is the product of the process" [53].

Many well-known scientists have tried to reveal the nature of the emergence of innovations and the forms of organization of enterprises that are most favorable for the implementation of innovative activities. Currently, among the models describing innovative processes, the most widespread are:

- the "technological push" model. This model was considered classical for a long time, since it was developed in their works by M.I. Tugan-Baranovsky [54], J. Schumpeter, G. Mensch. In this model, the latest achievements of science and technology are considered as a source of innovation. The "technological push" model is presented in the form of a sequence of linearly and cyclically repeating stages. This model was based on linearly sequential processes related to R&D, while the market is considered only as a consumer of innovations;

- the "demand call" model (market pull). Supporters of this model were K. Freeman [55] and D. Roman [56]. Within the framework of this model, it is assumed that commercially successful innovations appear as a result of timely and adequate response of knowledge-intensive industries to consumer requests. Market demand, which determines the directions of R&D, is considered as the basis of innovation processes. The sequence of

stages that make up the innovation process is linear;

- coupled model of innovation activity (coupling). It is based on the works of R. Rothwell [57], D. Moveri [58] and other scientists. This model combines the presence of stages that have the following characteristics: consistency, interaction with each other, functional isolation, which allows us to talk about the nonlinearity of the processes of creating innovations. The basis of the model is built around the development and design processes as the most resource-intensive stages of innovation activity. During the engineering and design stage, small but constant changes occur, which, as a cumulative result, have a high impact on the result;

- integrated model of innovation processes. M. Aoki is considered to be the founder of this model [59]. It is based on the integration of the ideas of several groups of specialists working in different directions. This approach leads to an acceleration of the process. Thus, the introduction of a new product to the market is most effective with the close cooperation of research, production, marketing, financial and other departments of the company. This process should be supervised by a special intersectoral working group;

- innovation process in the model of strategic networks. The main representatives are such scientists as R. Cooper [60], K. Oppenlander [61]. Unlike the previous model, it is not only inter-functional, but also inter-institutional, or network, in nature. The model considers the company's interaction with external agents (suppliers, consumers, competitors), the ultimate goal of which is innovation.

M.N. Rukavitsyna identifies two directions of creating an innovation management system: "integration of the full cycle of innovation activity into a continuous process and the allocation of innovation management into an independent management object" [62].

Based on the analysis of a number of scientific papers devoted to innovation, it can be concluded that in order to ensure the successful and dynamic development of an enterprise producing high-tech products, it is necessary first of all to widely apply various methods of innovation management, which should include simultaneous and coordinated use of technological, scientific, personnel, commercial and other policies that ensure system solution of innovative development tasks.

Conclusions. The main focus of the considered theoretical works is to provide conditions favorable for the creation of innovations, as well as to study the mechanisms that transform innovation from the idea stage to the final product. At the same time, in most of the considered works, insufficient attention is paid to the problems that have a negative impact on obtaining the results of innovative activity. The main risk accompanying innovation activity is considered to be market risk, however, the economic situation of recent years has shown that the feasibility of innovative projects to a large extent depends on the external economic environment of the project. Despite the large number of works in economics devoted to innovations and everything related to them, it should be noted a significant gap in the methodological support of the management of innovative activities of enterprises.

One of these areas is associated with linking the attribution of the industry to knowledge-intensive in terms of the ratio of R&D costs and the corresponding output volumes. Thus, A.E. Varshavsky classifies an industry as knowledge-intensive if "the indicator of knowledge intensity, calculated as the ratio of R&D costs to the resulting indicator of the industry's activity, exceeds the average or some level specific to the industry as a whole". When forming a criterion for classifying an industry as a knowledge-intensive I.E. Frolov refers to the knowledge-intensive industries in

which "the ratio of R&D costs to the corresponding output is 1.2-1.5 times higher than the global average in the manufacturing industry of developed countries and is 3.5-4.5%". Another area of classification of industries as knowledge-intensive is the assessment of the personnel characteristics of the enterprise. Thus, according to V.L. Makarov, A.E. Varshavsky and L.A. Fedorova, the knowledge intensity of the industry can be determined on the basis of the following relations: "the number of people employed in science and scientific services to industrial and production personnel of the industry; R&D costs to industrial and production personnel, the volume of the main production assets of the industry".

In modern conditions of economic instability, deep modernization of industry, including the restructuring of many enterprises of knowledge-intensive industries, the problem of increasing the efficiency of innovative activities of enterprises comes to the fore. It is the productive innovative activity of enterprises of knowledge-intensive industries producing products and services with high added value that should play one of the key roles in making a breakthrough from the raw material model of the economy to the innovative one. The ongoing and planned reorganization and modernization of knowledge-intensive industries will require enormous costs, so mistakes in planning and decision-making within the framework of innovation management can entail costly consequences. Hence, there is a need to improve the methodological apparatus for managing innovation activities of knowledge-intensive industries, the purpose of which is to support management decision-making. To do this, it is advisable to make an analysis of the existing practice of managing innovation activities of knowledge-intensive industries.

References

1.Ashurov, M.S., Kurpayanidi, K.I. (2021). Problems and solutions for the formation of a competitive national innovation system. Monograph. Al-Ferganus.

2. Kondratiev waves. Electronic resource: https://moneyman.ru/wikibank/volny-kondrateva

3. Schumpeter, J. A. (2007). Theory of economic development= Theorie der wirtschaftlichen Entwicklung: Theorie der wirtschaftlichen Entwicklung; Capitalism, Socialism and Democracy= Capitalism, Socialism and Democracy. Socialism and Democracy/translated from German: V.S. Avtonomov, M.S. Lyubsky, A.Yu. Chepurenko. –Moscow: Eksmo.

4.Twiss, B. C. (1984). Forecasting market size and market growth rates for new products. Journal of Product Innovation Management, 1(1), 19-29. a.Twiss, B. C. (1992). Forecasting for technologists and engineers: A practical guide for better decisions (No. 15). IET.

5.Santo, B. (2006). Innovation and global intellectualism. Innovations, 9, 32-44. a.Santo, B. (1990). Innovation as a means of economic development: trans. with Hung./total ed. B.V. Sazonova. M.: Progress.

6. Christensen, K. (2016). The innovator's dilemma: how strong companies die because of new technologies. Alpina Publisher. a. Christensen, C. M. (2013). The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Review Press.

7.Raynor, M., Christensen, K., & McDonald, R. (2016). Disruptive innovation: Twenty years later. Harvard Business Review, 29.

8.Lambin, J. J., Chumpitaz, R., & Schuiling, I. (2007). Market-driven management: Strategic and operational marketing. Macmillan International Higher Education.

9. Mensch, G. (1972). Basic innovations and improvement innovations. Journal of Enterprise Economics, (42), 291-297.

10. Kuznets, S. (2003). Economic growth: research results and reflections. Nobel Prize Laureates in Economics: Autobiographies, Lectures, comments/edited by Corresponding Member of the Russian Academy of Sciences V. Okrepilov, 1, 1969-1982.

11. Drucker, P., Porter, M., Prahalad, K. K., Norton, D., & Levitt, T. (2016). Business management. M.: Alpina Digital.

12. Porter, M. (2016). Competitive advantage: how to achieve a high result and ensure its sustainability. Alpina Publisher.

13. Yakovets, Y. V. (2004). Epochal innovations of the XXI century. Moscow: Economy.

14. Prigozhin, A. I. (1989). Innovations: incentives and obstacles:(Social. probl. innovatiki). M.: Politizdat, 270(1).

15. Utkin, E. A., Satabaev, K. T., & Satabaeva, R. K. (2002). Innovations in the management of human resources of the enterprise. M.: TEIS, 304.

16. Rumyantseva, Z. P. (2012). Search for innovative solutions in modern management (analytical review). Bulletin of the University, (5), 215-218.

17. Balabanov, I. T. (2008). Fundamentals of financial management. Uch. pos.-2izd. add. and reworked .

18. Ilyenkova, S. D., Gokhberg, L. M., & Yagudin, S. Yu. (2016). Innovative management: Textbook for Universities, Edition 4 reprint./Ed. SD Ilyenkova. M.: Banks and exchanges, UNITY.

19. Solomatina, N. A., & Slavnetskova, L. V. (2017). The coordination center of cluster development as the basis for the functioning of the innovation system in the context of integration. News of Saratov University. A new series. Economics series. Management. Pravo, 17(1).

20. Tsvetkov, A. N., & Boreisho, A. A. (2018). Quality management: the experience of theoretical understanding. Society: politics, economics, law, (10 (63)).

21. Kondratieva, N. D., Papaeva, A. A., Nevmatullina, H. A., Abrashov, A. A., & Grigoryan, N. S. (2020). Evaluation of quality indicators of innovative protective coatings/International Scientific Conference: "Standardization and technical regulation: current state and development prospects". Information and economic aspects of standardization and Technical regulation, (6), 158-166.

22. Vasilyeva, L. N., & Muravyeva, E. A. (2005). Methods of innovation management.

23. Tyurina, A. N. (2006). About budget financing of the scientific and technological complex of Russia (end). Accounting in budgetary and non-profit organizations, (5).

24. Tukkel, I. L. (2013). Methods and tools for managing the innovative development of industrial enterprises. BHV-Petersburg.

25. Schumpeter, J. (2007). Theory of economic development. Capitalism, Socialism and Democracy. Moscow: Eksmo, 864, 15.

26. Drucker, P., Porter, M., Prahalad, K. K., Norton, D., & Levitt, T. (2016). Business management. M.: Alpina Digital.

27. Drucker, P., Porter, M., Prahalad, K. K., Norton, D., & Levitt, T. (2016). Business management. M.: Alpina Digital.

28. Drucker, P. F. (2021). Encyclopedia of Management: [Based on the materials of ten books]. Peter F. Drucker.

29. Twiss, B. C. (1984). Forecasting market size and market growth rates for new products. Journal of Product Innovation Management, 1(1), 19-29.

30. Raynor, M., Christensen, K., & McDonald, R. (2016). Disruptive innovation: Twenty years later. Harvard Business Review, 29.

31.Christensen, K. (2016). The innovator's dilemma: how strong companies die because of new technologies. Alpina Publisher.

32.Santo, B. (1990). Innovation as a means of economic development: trans. with Hungarian. /Santo B. M.: Progress.

33. Mensch, G. (1972). Basic innovations and improvement innovations. Journal of Enterprise Economics, (42), 291-297.

34. Mensh, G. (1972). Basic innovations and improvement innovations. Journal of Enterprise Economics, (42), 291-297.

35. Fatkhutdinov, R. A. (2004). Innovation Management. St. Petersburg: Peter, 5.

36. Kultin, N. B., Surina, A.V., & Tukkel, I. L. (2011). Management of innovative projects.

37. Kultin, N. B., Surina, A.V., & Tukkel, I. L. (2011). Management of innovative projects.

38. Ogoleva, L.N. (2010). Innovative management: studies. Manual M.: Infra-M.

39. Bezdudny, F. F., Smirnova, G. A., & Nechaeva, O. D. (1998). The essence of the concept of innovation and its classification. Innovations, (2-3), 3-13.

40. Tsitsarova, N. M. (2009). Innovative management: a textbook/comp. NM Tsitsarova. Ulyanovsk: UISTU, 14.

41. Tsitsarova, N. M. (2009). Innovative management: a textbook/comp. NM Tsitsarova. Ulyanovsk: UISTU, 14.

42. Balabanov, I. T., & Dudin, M. N. (2001). Innovation Management. St. Petersburg: Peter, 304.

43. Belousov, V. M., & Spiridonov, M. A. (2003). Kiryakov AG, Maximov VA Fundamentals of Innovative Entrepreneurship: Study guide. Rostov n/A, 2002. News of higher educational institutions. The North Caucasus region. Social Sciences, (2).

44. Vasilyeva, L. N., & Muravyeva, E. A. (2005). Methods of innovation management.

45. Luzhinsky, I. Ya., & Pereverzev, M. P. (1998). Innovative management in small business. Tula: Publishing House of LN Tolstoy TSPU, 172.46.

Khanchuk, N. N. (2012). Innovative activity in the system of scientific categories. Innovations in Science, (11-2).

47. Manual, F. (2002). The Measurement of Scientific and Technological Activities. Proposed Standard Practice for Surveys on Research and Experimental Development. OECD Publishing ISBN: 9789264199033, 256, 2.

48.Krech, E. V. (2020). Classification of innovations: international experience.

49.The Oslo Manual "Recommendations for the Collection and Analysis of Innovation Data", Third edition Joint publication of the OECD and Eurostat. Moscow, 2010

50.Wulfen, G. (2014). Launching innovations. Illustrated guide to the FORTH methodology.

51.Pisano, G. P. (2015). You need an innovation strategy. Harvard business review, 93(6), 44-54.

52.Kaplan, S., & Foster, R. (2005). Creative destruction: why companies "built forever" do not show the best results and what needs to be done to increase their efficiency.

53.Barancheev, V. P., Maslennikova, N. P., & Mishin, V. M. (2014). Innovation management.

54.Tugan-Baranovsky, M. I. (1923). Periodic industrial Crises: A History of English Crises. book cooperative t-vo at the Small Regional Committee of the Russian Communist Party.

55.Freeman, C. (2013). Economics of industrial innovation. Routledge.

56. Roman, D. (2005). Science, technology and innovation. M: Knowledge.

57. Rothwell, R. (1994). Towards the fifth-generation innovation process. International marketing review.

58. Mowery, D. (1995). The practice of technology policy. Handbook of the economics of innovation and technological change, 513-557.

59. Aoki M. Firm in the Japanese Economy. Information, stimulation and conclusion of transactions in the Japanese economy [Text] / M. Aoki: trans. from English — St. Petersburg, 1995. — pp. 314-315.

60. Cooper, R. G. (1979). Identifying industrial new product success: Project NewProd. Industrial Marketing Management, 8(2), 124-135.

61. Oppenländer, K. H. (1977). Patent policies and technical progress in the Federal Republic of Germany. In Innovation, Economic Change and Technology Policies (pp. 307-329). Birkhäuser, Basel.

62. Kurpayanidi, K. I. , Mamurov, D.E.(2022). Management of innovative activities of business entities in industry: AL-FERGANUS, 200 p.

MAIN CHARACTERISTICS OF THE RISK MANAGEMENT MECHANISM IN MANUFACTURING ENTERPRISES

MUXITDINOV SHUXRAT

Associate Professor of Namangan Institute of Engineering and Technology
E-mail: muxitdinov85@list.ru

Abstract:

Objective. Improvement of risk management mechanisms in production enterprises is of particular importance. Because risks are characterized by different levels of danger depending on the type. This article provides detailed information about risks in the management of production enterprises and their classification into types and levels when taking into account the amount of damage.

Methods. The research methods were statistical, comparative analysis, induction and deduction methods.

Results. The scale of business in our country is increasing, which leads to meeting consumer demand, increasing the scale of national production, and increasing the share of production and services in the GDP, but there are always different levels of support for businessmen. participants face financial or other types of losses as a result of the mysterious factors. It is especially important to improve the risk factor management mechanisms affecting the stability of production enterprises. In this article, a scientific proposal and practical recommendations have been developed to prevent risks affecting production enterprises and to improve their management.

Conclusion. Sometimes the risks have a high level, and their level of danger can increase the amount of the company's losses, sometimes there are insignificant risks, which almost do not affect the net profit, and can lead to a violation of the management mechanism. From this point of view, it is desirable to improve the mechanisms of their management, regardless of the level of risks.

Keywords: production, risk, risk levels, light industry.

Introduction. One of the main types of production is industrial production. The essence of industrial production consists of two types, which are divided into heavy and light industries.

Industry is the largest and leading branch of material production. The majority of labor tools (tools), labor goods and consumer goods are created in it; all types of machines and mechanisms, structural elements of buildings and structures are produced; mining of underground resources is carried out; mineral, vegetable and animal raw materials are processed, consumer goods are made, etc. [1]

The President of the Republic of Uzbekistan, Shavkat Mirziyoyev, in his Address to the Oliy Majlis, touched on this

and noted that "... in the reporting year, the balance was achieved in the economic and social spheres of our country, and high speeds were ensured due to modernization and diversification, which is a clear confirmation of this. . That is, ... 161 large industrial facilities were put into operation in our country in a short period of time. They say that this will allow us to produce an additional 1.5 trillion soums worth of products next year [2].

Methods. Statistical analysis methods, monographic observation, induction and deduction, abstract thinking, economic-mathematical modeling, expert and rating evaluation methods were widely used in the research process.

Literature analysis. Industrial risk should be understood as a risk arising from any type of activity related to the production of products, their sale, commodity-monetary and financial operations, marketing, commercial, socio-economic and scientific-technical projects [3].

A. Grigoryans stated in his scientific research that "Risk in industrial production is defined as a generalized characteristic of the situation, a decision-making process in conditions of uncertainty, if some reason does not allow to make an optimal decision to achieve the goal, then it creates a risk" [4].

When talking about the historical development of industrial production and its main results, the scientist of our country A. Artikov, it should be noted that the development of "Home industry" in the territory of modern Uzbekistan dates back to 12-15 thousand years ago - in the Mesolithic period. started During this period, very simple work tools and items were made. During the New Stone Age (Neolithic, the beginning of the 5th millennium BC), shipbuilding and textiles appeared. At the end of the Neolithic period, metal weapons began to be made. It is known from archaeological finds that the people living in the territory of present-day Uzbekistan knew how to make copper weapons at the end of the 3rd millennium BC [5].

Sh.D.Saidboyev, K.Sirojiddinov, one of our scientists, noted that "threats (risks) faced by industrial enterprises mean the possibility of occurrence of factors that cause damage to enterprises or adversely affect the smooth running of production processes." [6].

Results and discussion. As a result of the liberalization of the economy, expansion of production and wide opportunities for business activities, the industrial economy is recording growth from year to year (Table 1).

Table 1

Structure of the manufacturing industry in the Republic of Uzbekistan (as a percentage)[4]

№	Name	2017	2018	2019	2020	2021
1	Production of textile products	13,9	13,1	11,8	12,0	13,7
2	Clothing production	5,1	4,1	3,6	3,4	3,5
3	Manufacture of other finished goods	0,9	0,7	0,6	0,6	0,6

The table shows that the production volume of textile products in the industry increased by 1.7% in 2021 compared to 2020, but decreased by 0.2% compared to 2017, and the volume of clothing production decreased by 0.1% compared to 2020. The indicator decreased by 1.6% compared to 2017. The production of other finished goods recorded a similar indicator in the last three years, but it also decreased by 0.3% compared to 2017.

---

[4] Author's development based on the information of the State Statistics Committee of the Republic of Uzbekistan

The production of industrial production includes many sectors, among the sectors, the sector with a high share with its growth figures from year to year is mainly textile production.

"On urgent measures to support the textile and knitwear industry" to support and further develop the textile and knitwear industry today Decree No. PF-5989 dated May 5, 2020 of the President of the Republic of Uzbekistan was adopted [7]. The decree stipulates the implementation of the following measures:

- rapid solution of transportation and logistics issues of raw materials, materials, finished products, as well as production employees of textile and sewing-knitting industry enterprises;

- development and implementation of measures to reduce the cost of manufactured textile and sewing-knitting products and increase their competitiveness;

- search for new promising foreign markets, stimulate the export of local textiles and sewing and knitting products;

- tasks such as the development of clothing designs and collections and their introduction to network enterprises are defined.

As a result of the implementation of this decree, it will contribute to the development of textile enterprises and improve the mechanisms of its state support and management.

By establishing an effective management system in industrial enterprises, it will be possible to reduce the effects of risk in production. The essence of risks in industrial production is different and they affect different criteria of activity (Fig. 1).
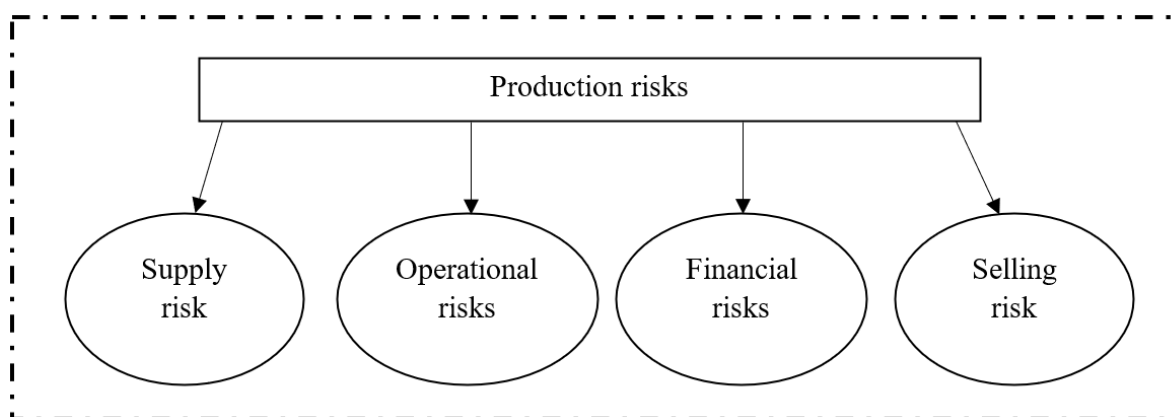

Figure 1. The main risks in industrial production[5]

It can be seen from the picture that the risk of supply includes situations related to the delivery of raw materials. Operational risks are associated with various accidents, destruction and losses that may occur in production. Financial risks are related to the effect of interest rates of loans or investments on production profits, while sales risk is directly related to fluctuations in the economy and market balance.Ishlab chiqarish korxonalarida risklarni boshqarish mexanizmlarining o'ziga hos uslubiyoti mavjuddir. One of the most important of these is, of course, risk assessment. There are many approaches to the theoretical foundations of risk assessment, including economic analysis, mathematical modeling, SWOT analysis, sociological survey, evaluation matrix, and others.

The main purpose of the risk assessment matrix is based on the results of risk analysis and assessment, so the assessment matrix is an important component of management (Table 2).

---

[5] Муаллиф ишланмаси

Table 2

Risk assessment matrix in manufacturing enterprises [6]

Risk assessment matrix						
1	Big losses	II	II	III	III	III
2	Losses	I	II	III	III	III
2.1	Heavy	I	II	II	III	III
2.2	Light	I	I	II	II	III
2.3	It doesn't matter	I	I	I	I	II

As can be seen from the table, risks are divided into small types for the production enterprise: large losses and the probability of causing losses are being promoted. Also, the loss factor itself consists of three components: heavy, light and insignificant. Big losses can occur on the basis of technological, household and financial effects. Losses are divided into 3 types: heavy, light, insignificant. Heavy losses are risks arising mainly from financial losses. Small losses create supply and market risks. Insignificant losses occur due to temporary interruptions of medical resources, delays in supply, and other minor problems.

Conclusions and suggestions. If we make a conclusion based on the risk assessment matrix in production enterprises, it shows the need to develop effective mechanisms of risk management and put it into practice. The word "mechanism" is used more often in works related to technique and technology, and this term is also used in modern economy and research works of scientists. Especially in the field of management, the term "mechanism" is widely used in the development of many economic and management models, and the term mechanism is used to make several types of factors appear as a single whole.

References

1. Abdurahim Artikov. "Industrial economy" (Textbook). — T.: TDIU, 2009, p-21
2. Address of the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis. People's word December 23, 2017. No. 258 (6952).
3. Kostin Yu., Bychkin A. How to manage risks // Financial Director, No. 9, 2003
4. 4. Ter-Grigoryants, A.A. Risks in agriculture [Text]: monograph / A.A. Ter-Grigoryants. - Ministry of Education of the Russian Federation, North Caucasus. state tech. un-t. - Stavropol: SevKavGTU, 2004. - 175 p.
5. Abdurahim Artikov. "Industrial economy" (Textbook). — T.: TDIU, 2009, p-27
6. Saidboyev Sh.D. Sirojiddinov K. "Management of bank risks and credit". Study guide.-"Namangan" publishing house 2014. p. 18.
7. Decree of the President of the Republic of Uzbekistan No. PF-5989 "On urgent measures to support the textile and sewing-knitting industry" (https://lex.uz/docs/4805518).

---

[6] Муаллиф ишланмаси

GREEN ECONOMY AND GREEN GROWTH. INITIAL EFFORTS OF SUSTAINABLE DEVELOPMENT IN UZBEKSITAN

NAJMIDDINOV YAKHYO

Assistant of Tashkent State University of Economics
E-mail: 19yzd96@gmail.com

Abstract: Green economy and green growth play a key role in the transformation to the sustainable development from traditional development. In the world all nations are trying to change their traditional economy to the sustainable economic development in the form of green economy and green growth.

In this paper, we have taken mostly into consideration all fields of green economy such as creating energy efficiency policies, enhancing to produce green product and increase the consumption of green products, promoting green jobs, upgrading environmental and socioeconomic impacts of the country's latest green economy policies and green growth strategies for the upcoming years. We have tried to demonstrate profitable sides of the long term sustainable development rather than short term benefits of the new policies.

Keywords: Green economy, green growth, sustainable development, socioeconomic, green economy policy, green growth strategies, climate change, natural resources, human wellbeing, traditional economy, renewable energy.

Introduction. The concept of green economy has been evolved since 1972 at the UN Conference on the Human Environment declaration "We have only one earth" [1]. But this idea green economy and green growth or sustainable development has been the core idea of the economy of all nations in the late on XX century and XXI century. We have seen the UNEP statistics, Green Economic Institution articles, High-Level Political Forum on Sustainable Development (HLPF) and Green Growth Knowledge Platform (GGKP) annual reports about the green economy and green growth. European countries have encountered green economy and green growth more deeply than other countries, cause more people who is living in these areas are wants to life safe, ecofriendly, fresh air places, even they want to buy the products that have been produced in the form of green products more expensive tant the goods that have been manufactured in the form of traditional economy.

Like other nations, Asian and central Asian countries also have given their great attention to the sustainable development. Korea, Japan, China and other well developed countries in Asia also have great experiences towards the sustainable development. In Asia the most complex and crucial socio-economic phenomenon of the twenty first century is rapid urbanization and more scarce recurse than passed centuries. It represents significant irreversible changes in production and consumption and in the manner in which people interact with nature.

Our today's economy and our way of life today are based mainly on of fossil fuels, which not only threaten essential environmental and social problems through global warming in the entire world, Aral sea phenomenon in central Asia, at actual consumption rate, will run out within few decades, causing enormous industrial and economic disaster. Uzbeksitan is one part of many nations who is suffering these phenomenon (Aral sea disaster). Lots of efforts have been made to tackle this problem and in order to get long term sustainable development we should change our behavior towards the economy, step by step new rules and legislations have to be made to change traditional economy to the green economy and green growth. Finally, mankind understood that nature is one, resources are scarce but our behavior towards the nature is not good, even worse. Green economy is one that promotes economic opportunities that are

not conflict with environmental sustainability and social well-being. It also promotes environmental objectives that can provide new forms of social economic opportunities.

Green economy can be one tool that manages social equity, human well-being, with an improved economy while reducing ecological and environmental risks. This paper will give a general idea for green economy, green growth and sustainable development through international case studies that applied this concept to the cities of Uzbeksitan and their environments. Finally, this paper will focus on new rules and legislation towards the green economy and sustainable development, by analyzing them give reliable recommendations to create better eco-friendly life in Uzbeksitan.

Literature review. There is no literally accepted definition of the term "green economy" and "green growth". The core idea of the "green economy" derived from the idea of UN Conference on the Human Environment "We have only one earth" [1], but the term "green economy" was first coined in a pioneering 1989 report for the Government of the United Kingdom by a group of leading environmental economists, entitled "Blueprint for a Green Economy" [2]. Although there are no exact priority concepts related to the green economy, a number of the EU's headline and Asia's headline priorities and sector specific strategies and policies could form part of the green economy transition.

Although the green economy has a legacy from "Limits to Growth arguments" [4] and the "Blueprint for a Green Economy" [3], currently iterations of the green economy entered mainstream policy discourse towards the end of the 2000, for now it is notably main idea for all economists from the UNEP's green economy reports.

The concept of a "green economy" does not replace sustainable development, but there is now a growing recognition that achieving sustainability rests almost entirely on getting the economy right. Decades of creating new wealth through a "brown economy" model have not substantially addressed social marginalization and resource depletion, and we are still far from delivering to the Millennium Development Goals. Sustainability is still a vital long-term goal, but we must work on greening the economy to get us there.

"Green economy" and "green growth" have many definitions which pay attention to different points. (See table 1). It is defined as a sustainable economy and society with a one-planet footprint where all energy is developed from the renewable resources. Green economy sectors include, for example clean technologies, improved freshwater infrastructure, sustainable energy, low carbon transport and energy efficient design, waste management clean technologies, sustainable agriculture energy and forestry. According to the UNEP (2011), a green economy is an economy caused by significantly reducing environmental risks through improved human welfare and social equity. In such sort of economy, all types of investments that reduce pollution and carbon emissions, improve resource and energy efficiency beside stop loss of biodiversity and footprint impacts are main elements affected income and employment.

Table 1.

Some green economy definitions

Source	Definition	Link
(UNEP)'s working definition, 2012	"Green economy" is an economy that results in improved human well-being and reduced inequalities over the long term, while not exposing future generations to significant environmental risks and ecological scarcities	UNEP 2012 annual report	UNEP - UN Environment Programme
International Chamber of Commerce, Green Economy Task Force	The green economy is an economy in which economic growth and environmental sustainability work together in an mutually reinforcing fashion, while supporting progress and social development.	ICC's new task force on Green Economy announces Chairperson - ICC - International Chamber of Commerce (iccwbo.org)
EEA (2013)	The green economy is one in which environmental, economic and social policies and innovations enable society to use resources efficiently–enhancing human well-being in an inclusive manner, while maintaining the natural systems that sustain us.	EEA 2013 Work Programme to Address Air Pollution, Climate Change, Energy	News	SDG Knowledge Hub	IISD

Green economy and green growth are not the same thing, "green economy" was evaluated by the Europe meanwhile Asian countries like Korea, Japan, China, Indonesia came up with new idea "Green growth" at the beginning of the XXI century. At the "Fifth Ministerial Conference on Environment and Development" (MCED) [5] held in March 2005 in Seoul, 52 Governments and other stakeholders from Asia and the Pacific agreed to move beyond the sustainable development rhetoric and pursue a path of "green growth". To do so, they adopted a Ministerial declaration (the Seoul Initiative Network on Green Growth) and a regional implementation plan for sustainable development. This commenced a broader vision of green growth as a regional initiative of UNESCAP, where it is viewed as a key strategy for achieving sustainable development as well as the Millennium Development Goals (in particular 2 and 7 relating to poverty reduction and environmental sustainability) (UNESCAP, 2012).

There are many definitions to the "Green growth" but one of the important one is definition of OECD in 2011, "green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities"

Classical growth theory assumes that output Q is produced using technology and human capital A, physical capital K, and labor L. The relationship among these inputs in the production, we can write in a mathematical way like this function:

$$Q = f (A, K, L)\ [6]$$

In this formula we can demonstrate classical growth in production factors K and L, growth in productivity Q (quantity). Growth in labor L is explained by population growth, labor force participation and improvements in health and education. Growth in K is explained by investment, and growth models assume that a share of output is used to increase the stock of capital K. Growth in A is explained by technological change, including changes in organization and practices, and by social capital improvement.

The environment becomes "natural capital", directly needed for growth, and environmental management becomes a

265

productive investment, directly comparable to investment in physical capital. A failure to manage the environment results in the depreciation and destruction of natural capital, with direct impacts on output. We thus have:

$$Q = f (A, K, L, E) \text{ [7]}$$

Here we can see E as environmental challenges. This demonstrates green growth rather than classical growth. All nations are trying to take into consideration environmental challenges in producing different products. As we know resources are limited, we should treat well towards the natural resources on earth.

Discussion. Global climate change threatens to disrupt the well-being of society, undermine economic development and alter the natural environment, making it a key policy concern of the 21st century. Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UN, 1992). Climate change also has been damaged one part of our nation, Uzbekistan. One of the essential sea of the central Asia is situated in Uzbekistan, Aral sea. Most parts of the Aral sea has been droughted by the nations which is situated in central Asia in the form of using incorrect way, so should try to safe our nature, our well-being, our economy. To do this we should support the idea of "Green economy", "Green growth" and sustainable development.

Worldwide, all nations have their own prospective towards the green economy and green growth. But, green economy has some multiple proses in general, we can see them in the following table 2. They figure out that all thing should be green like green jobs, green technology, green tourism, green food, green products, green nature green building and green services and green structure. All these terms have already taken an action in Europe and supported in the form of RDPs (Rural Development Programmes).

Table 2.

Multiple benefits of green economy
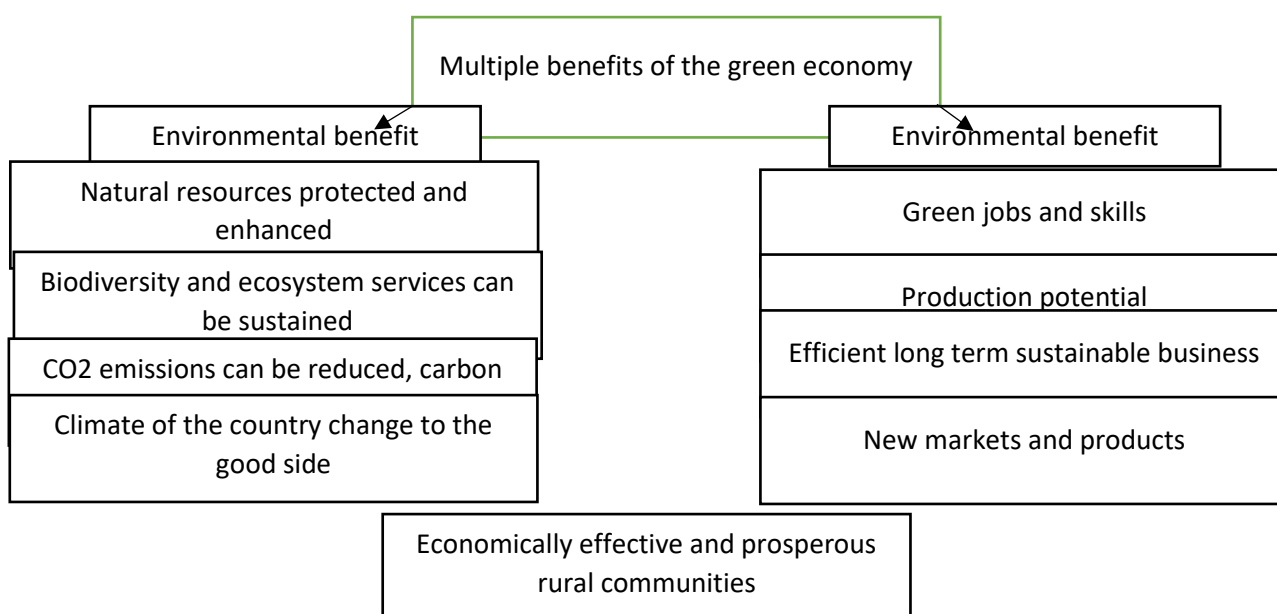
Uzbekistan recognizes that moving a low-carbon emission is important for the future prosperity and environmental sustainability. There are many rural areas

that are not being used, by understanding this we should create green places and green jobs by using these lands. To transform the economy of Uzbekistan into the new economic system by including the green growth, green economy and sustainable development inside the new economic system. By understanding these conditions President of the Republic of Uzbekistan Sh.M.Mirziyoev has signed decision "On the measures to increase the effectiveness of the reforms implemented in the Republic of Uzbekistan to transition to a "green" economy by 2030" [8] to establish green economy, green growth and sustainable development. This decision includes many essential tasks that we have to tackle year by year in the late of 2030. The main issues indicated in this decision are the implementation of the tasks defined in the development strategy of New Uzbekistan for 2022-2026, the "green" and inclusive economic transition within the framework of the strategy of the transition to the "green" economy of the Republic of Uzbekistan. The work to be done in order to increase the effectiveness of the measures to ensure energy, use of renewable energy sources, and to further expand the saving of resources in all sectors of the economy is consistently and clearly indicated. Problematic issues related to climate change have a negative impact on the effectiveness of reforms implemented in the country, in particular, on economic growth and poverty reduction, as well as ensuring environmental and food security. Based on this, in this direction, great attention is paid to reducing the impact of climate change and adapting to it, accelerating the transition to a "green" economy, and promoting a "green" and inclusive economic growth model. To increase the effectiveness of the measures taken on the development of the "green" economy based on the strategy of the transition to the "green" economy of the Republic of Uzbekistan in the period of 2019-2030, as well as the cooperation of state authorities and management bodies with international organizations in this direction. to ensure coordinated efforts in mutual cooperation created the need to develop a program. The following main goals and tasks are clearly defined in the green economy development program.

The program of transition to "green" economy and ensuring "green" growth in the Republic of Uzbekistan until 2030 includes the following chapters.[10]
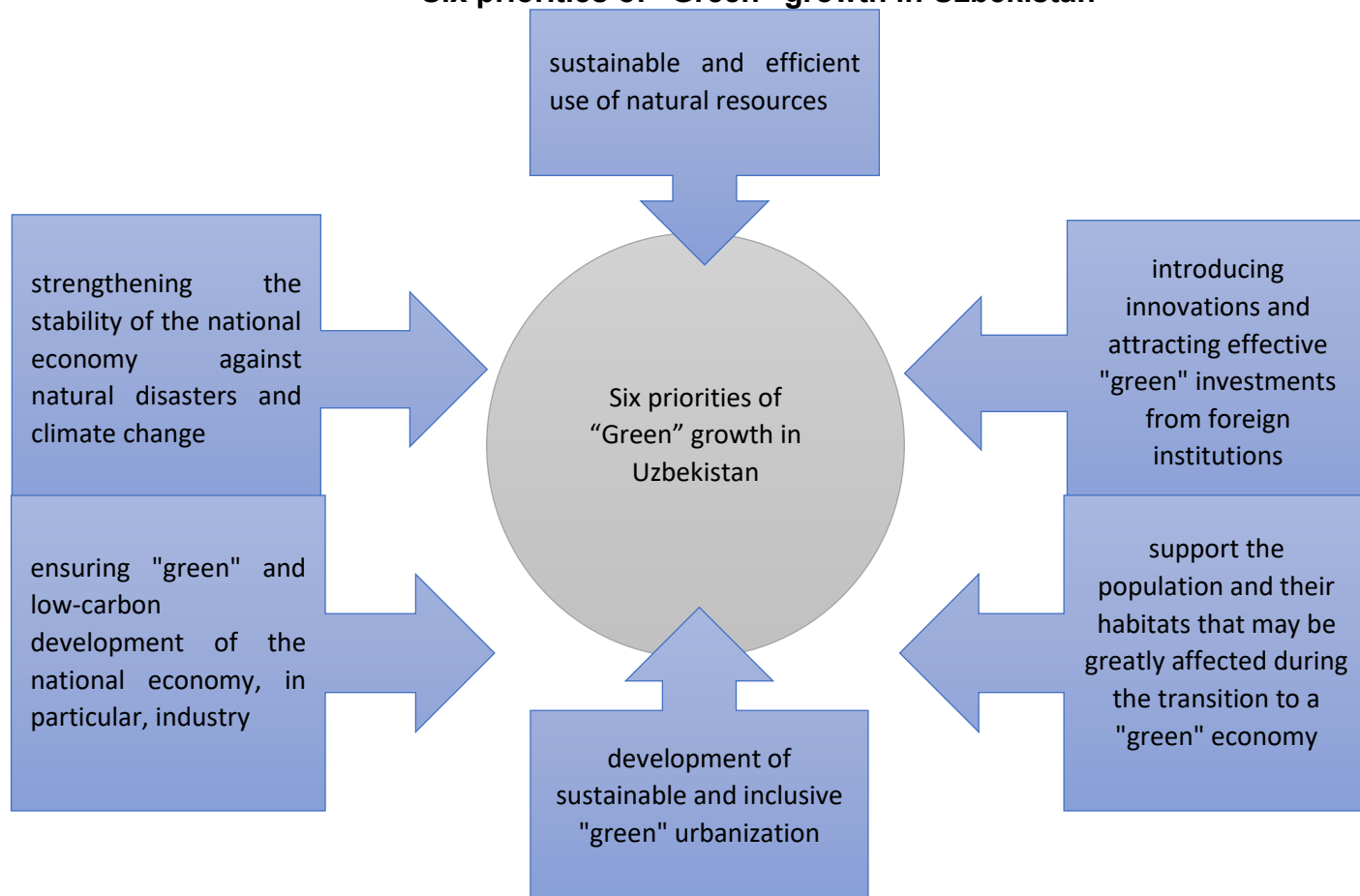
Graph 1.

"Green" growth priorities

Goals and objectives of the program

Program implementation mechanism

Monitoring and Evaluation (M&E). Expected results

Monitoring and Evaluation (M&E). Expected results

The priorities defined in this program are based on a number of strategic directions in the fields that exist at the national level and strengthen their complementary aspects, for example technological modernization and introduction of "green" technologies, increasing literacy of the population in the field of "green " economy, supporting "green" investments from the foreign institutions, etc. The program defines the tasks of ensuring "green" economic growth in the Republic of Uzbekistan in the following graph 2.

Graph 2.

Six priorities of "Green" growth in Uzbekistan

sustainable and efficient use of natural resources

strengthening the stability of the national economy against natural disasters and climate change

ensuring "green" and low-carbon development of the national economy, in particular, industry

Six priorities of "Green" growth in Uzbekistan

introducing innovations and attracting effective "green" investments from foreign institutions

support the population and their habitats that may be greatly affected during the transition to a "green" economy

development of sustainable and inclusive "green" urbanization

Along with all countries, it is necessary for us to develop measures against climate change not only for our economic system, but also for improving external economic relations, improving the well-being of the population, and showing that we are a country that has its place economically in the world. The development of the green economy sector started with the decision of PQ-4477 dated October 5, 2019, adopted by our president, and the 26th session of the United Nations Framework Convention on Climate Change held in November 2021 (COR26) within the framework of the Paris Agreement, the Republic of Uzbekistan undertakes an additional obligation to reduce greenhouse gas emissions per unit of gross domestic product by 35 percent compared to 2010 levels by 2030 [11], we can mention this measure as a consistent continuation of activities in this field.

Conclusion. In 2019, President of Uzbekistan has signed an order related to the proposed green growth and green economy. From that time, we have been trying to change the economy in the good side, long term sustainable development. We should not forget that to establish green economy and green growth in one country

firstly, this country has to be ready this change. As knowing these conditions we set many tasks to tackle in the next decade. At present climate issues have gradually evolved into a focus of international political, social and economic competition. Whether green growth can be achieved could determine the outcomes of this competition. We are not part of this competition nowadays, but we will be main part of this competition in a few years. In Europe like Germany, Italy, Spain, UK and in Asia like Japan, Republic of Korea, China, Vietnam, Malisa countries' economies are mainly contain green economy and sustainable development. They have many concepts, action plans, priorities to get long term sustainable development.

We should not forget that everything have to be hard at the beginning. In order to get long term sustainable development, in some cases we should lose, we should not choose benefits of usual economy's short term benefits. On the one hand, green growth help achieve carbon reduction and sustainable development in the long run, on the other hand, it may force high-emission industries stop their operating. By studying and learning many scholar's articles, reports, publications and our president Sh. M. Mirziyoev's signed order, I have these recommendations in general.

Firstly, before turning into the green economy from traditional economy, we should give some illustrations about the green economy and its effects to the well-being, social life to the population its proses to the economy, cause most people nowadays want to live in developed cities or capital of the Uzbekistan but green economy mostly related to the RDPs (Rural Development Programs). So, if we want to enhance the green economy and green growth in Uzbekistan, we should create well social life in rural places, but now it is somehow costly for Uzbekistan.

Secondly, among our population there is no exact idea what is the green economy and green growth, we should broadcast information about the green economy in publicly.

Lastly, we should give grands to the scholars, who knows green economy better than others, to get more knowledge in this area in well developed countries like Germany, Italy, Korea, Indonesia and so on.

A limitation of this study is lack of analysis of industry-level data related to the green economy, as in Uzbekistan lack of organizations are producing green products. We use all information we have related to the green economy in Uzbekistan. In our follow-up study, additional studies will be done on specific industries, thus providing new insights.

References

1. Sh.M.Mirziyoev. "On the measures to increase the effectiveness of the reforms implemented in the Republic of Uzbekistan to transition to a "green" economy by 2030". Uzbekistan. 2019.

2. UN Conference on the Human Environment declaration. Europe. "We have only one earth" 1972.

3. David W. Pearce. Blueprint for a Green Economy – Europe. 1989.

4. Deadows concepts. Limits to Growth arguments – Europe. 1972

5. Radoslava Kanianska. Green growth and green economy. Banská Bystrica. 2017-page 21.

6. Radoslava Kanianska. Green growth and green economy. Banská Bystrica. 2017-page 22.

7. United Nations Framework Convention on Climate Change held in (COR26). Europe. November 2021

8. Malin Song, Shuai Zhu, Jialian Wang, Jiajia Zhao. Share green growth. Regional evolution of green output performance in China. 2020

9. Mohammad Refaat Mohammad Abdelaal, Islam Sallam. Green economy themes. Pathway to sustainable urban development. 2019

10. Eu Rural Review. Green economy opportunities for rural Europe. Europe. 2017.

11. Adrian C. Newton and Elena Cantarello. An introduction to the green economy. London, New York. 2014.

Networks.

12. www.greeneconomics.org.uk

13. www.unep.org

14. www.enrd.ec.europa.eu

15. www.oecd.org

THE METHODS FOR MEASURING THE EFFECTIVENESS OF SOCIAL ENTREPRENEURSHIP ACTIVITY

NARZULLAEV ELMUROD

Doctoral student of Namangan Institute of Engineering and Technology
E-mail: narzullaevelmurod@gmail.com, phone.: (+99891) 363-61-61

Abstract:

Objectives: The main objective of this study is measuring capability of a wide range of social enterprises. The theoretical basis of the scale is supported by empirical research in the social sector. The scale provides a valid, reliable tool for measuring a wide range of SE in firms which meets different types of properties that required for measuring scales in the validity, social sciences or reliability.

Methods. Within the framework of the problem of measuring efficiency social entrepreneurship describes the most common and popular approaches and measurement methods forms and content achieved by social entrepreneurs the results of their activities. The most common problems of measuring and evaluating social outcomes and social effects faced by social entrepreneurs who firmly believe that indicators of accuracy and interpretation of results allow them to deepen your knowledge and understanding of the true situation organization and their real status in the community of social entrepreneurs.

Results. The results of this study analyses that the measuring the activity of social entrepreneurship is integral part of developing and managing SE in every single society. It was evident that social entrepreneurship has remarkable contribution in triple-bottom-line components of community development. In order to measure the activity variety of methods are analyzed alongside and in order to calculate the efficiency of SE new formula is offered.

Conclusion. The development of social entrepreneurship has become widespread throughout the world, including in Uzbekistan. In view of the rapid spread of this new direction of entrepreneurial activity, it became necessary to develop an appropriate methodology for a comprehensive assessment of the effectiveness of social enterprises. This article will be of interest to undergraduates, graduate students, entrepreneurs and researchers in the field of social entrepreneurship.

Keywords: social entrepreneurship; social and financial value; social and economic efficiency, social project, social benefit, measuring social effect;

Introduction. The social sphere is a complex of both public and private institutions whose activities are aimed at sustainable socio-economic development of the regions, maintaining and improving the quality of life of the population. Branches of the social sphere are called upon to meet the material, spiritual, educational, medical, cultural and social needs of the population. The most important social category that characterizes the general level of well-being, as well as the degree of satisfaction of human needs, is the quality of life.

Managing the quality of life of the population is a process that "is an integral part of a complex and multifactorial system, which includes many indicators and indicators to measure its level"[7]. The presence of a developed social infrastructure is designed to ensure a high standard of living in the country.

Methods. Today in the community of social entrepreneurs a significant number of those who are not sufficiently aware of existing approaches and methods for assessing social the impact of their activities. Foreign experience shows that the need to measure social outcomes and social effects is constantly increasing, since social organizations must constantly prove their social significance.

However, due to the lack of a standard system and convenient tools for measuring social outcomes left to discretion of management and stakeholders on voluntary beginnings - based on faith, intuition and case analysis. Many social entrepreneurs do not measure social results, and few measure, but not systematically[8]. Consider the current practice of assessing social effects, socially significant results obtained in the field of social entrepreneurship. Most social entrepreneurs use common form of measurement, which is passing on stories representing examples of success to their sponsors and other interested parties. Most case histories are critical to uncovering qualitative information[9].

When we are talking about methods of describing the social effect. Descriptive techniques ("stories and cases") aim to receiving feedback from stakeholders on the achieved social results and social impact, but their measurement is not held. Descriptive techniques, therefore, reveal results and best practices, factoring out efficiency[10].

---

[7] Ageenko A.V. The problem of assessing the satisfaction of the population with the quality of social services for the purpose of managing the quality of life in municipalities

[8] Рождественская Н.В., Богуславская С.Б., Боброва О.С. Оценка эффективности проектов некоммерческих

организаций, социального предпринимательства 2016.-168 с.

[9] Тимохович А.Н., Никурадзе О.И. Измерение эффективности предпринимательства// 2020. №7.

С.193-198.

[10] Ageenko A.V. The problem of assessing the satisfaction of the population with the quality of social services for the purpose of managing the quality of life in municipalities // Economics, management, finance: Collection of conference materials. – Perm: Mercury, 2011. – 123 p. – P. 5-8.
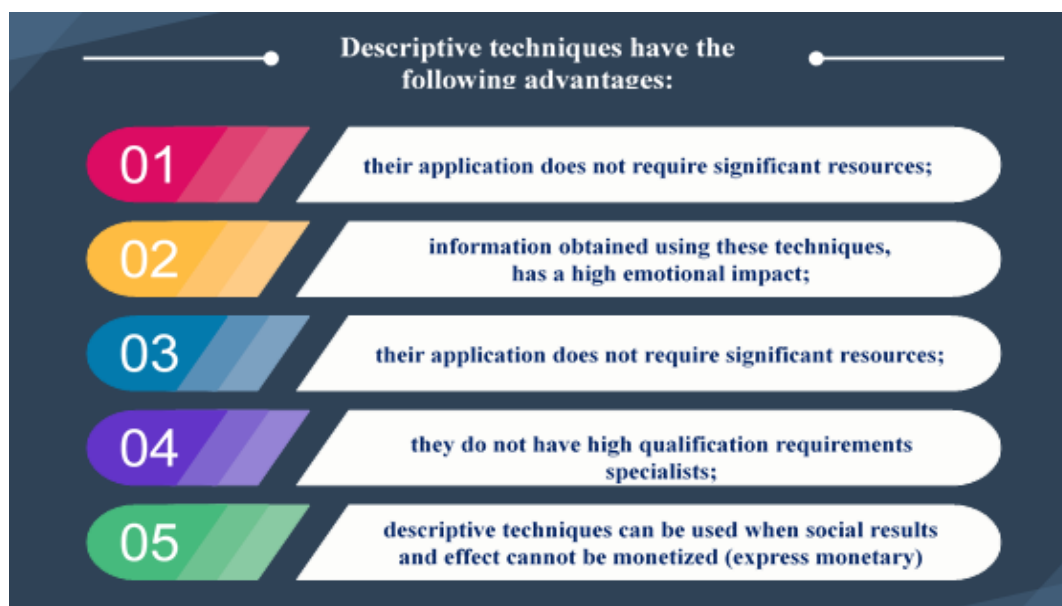
Figure 1. The advantages of Descriptive techniques method[11]

Another method do measure SE is the logic of a socially oriented program which describes the connection specific actions taken and the implementation of the mission program through the achievement of the objectives of the program and the decision tasks. This logic has a hierarchical structure: upon successful performing actions, the tasks of the program are solved, while solving tasks, the goal of the program is achieved, and the achievement of the goal of the program contributes to solving a larger problem (implementation of the mission of the program)[11].

The logical model of a program is a structured visual understanding of the relationship of resources invested in the program, applied actions and strategies, and those social changes that which need to be achieved. The logical model is a tool with which you can plan a project, analyze current activities, as well as present project stakeholders information in a lapidary and accessible form.

The logical model (theory of change) is a tool control used to improve the structure of the program not only at the design level, but also at the implementation level project. It includes such strategic components project, as inputs, results, end products, impact.

---

[11] Фейербах Л. Сущность христианства // Избранныефилософские произведения. Т.2-. М.:1955.-420 с

The chain of results to measure social effect

Figure 2. The chain of result to measure social effect

Discussion. In the last decade, the idea of social enterprise has been gaining popularity, which set their task not only to achieve profit, but also to solve other problems. If a few years ago, the social entrepreneur was soon an exceptional figure, then now the phenomenon of social entrepreneurship is becoming mass. Don't start the chain Our reaction, which in the early 70s of the last century made a popular effect: appearance of the first investors increased the interest in the industry and, accordingly, the number of entrepreneurs. Spiral of the beginning unrolling[12]. The number of entrepreneurs and investors increased. The same thing happens and now, in the sphere of social entrepreneurship, the number of enterprises and the number of projects.

Evaluation of the effectiveness of promising social projects, as well as the socio-economic activities of social enterprises in general, can be carried out at different levels of the country's economy. However, it should be noted that the existing methodological approaches to assessing the performance of social enterprises, the set of indicators included in the calculation of efficiency, as well as their priority for each level may differ[13]. In addition, a set of measures that is effective at one level may be associated with some costs that will reduce the effectiveness of

activities at another level. Still, it can also be the other way around. Thus, when evaluating efficiency at the enterprise level, first of all, emphasis is placed on the economic results of the implementation of current and prospective projects and their impact on the performance of a social enterprise. Naturally, given the social orientation of the enterprise, the social consequences of the activities carried out by it within the framework of the goals of the project should be taken into account[14].

The success of many social enterprises or a social designs carried out by own formulated programm in terms of achieving the final result. For its evaluation, such concepts as effectiveness, efficiency, quality assessment are most often used, which are formed on the basis of the tasks and goals of both the social enterprise itself and the implementation of the social policy of the society, which provides social services and the provision of social services to the population within a certain region or the whole country.

As part of the implementation of any social project, the goals of the enterprise can be both universal and specific, due to a certain type of social enterprise and oriented in accordance with the characteristics of the region in which the project is being implemented.

---

[12] A.A. Plyukhina, "Improvement of the method for assessment of social enterprises' activity ", - 2016 Moscow

[13] Минаев А.В. Критерии и методы оценки проектов социального предпринимательства // Труды

Московского физико-технического института. – 2011.

[14] Минаев А.В. Критерии и методы оценки проектов социального предпринимательства //. – 2011

Results. The analysis of the performance of a social enterprise can be described by the following algorithm, which includes[15]:

1. Research and preliminary strategic marketing planning. At this stage, the general socio-economic situation of the region is studied, a number of problems of its development are identified, as well as the perception by certain groups of the population of the nature of social projects, their main goals and results, changes and impacts arising in the course of practical activity

2. The next stage is the definition of the target audience for which the social project is aimed, the identification of direct or indirect consumers of public goods and their expected end result from the implementation of the project.

3. Establishing the boundaries of the analysis. Within the framework of this step, specific goals and directions of the impact of the social project are determined, as well as the period and parameters of functioning.

4. Development of a scorecard and development of indicators. At this stage, the nature of social benefits, the nature of the impact and changes that occur during the social project are substantiated. Social benefits are formed, and the social value created in the process of project implementation is determined.

5. Definition of forecasts. As part of this step, funding sources are identified, financial performance and reporting are examined, and the impact of various performance indicators on social, economic, and environmental outcomes being created is assess.

6. Calculation of the social efficiency of the project. The stage provides for the calculation of the reduced cash flows for the project based on the collected data, the developed implementation model and forecast data. The calculation of such indicators as the payback period, profitability of invested capital, and the amount of actual expenses are taken into account. It is important to analyze the risk factors at the project implementation stage.

7. Formation of reporting and development of measures to improve the activities of the social enterprise.

Evaluation of the performance of social enterprises is based on performance indicators and criteria. Efficiency and quality assessment is an integral part of the overall quality assurance system, within which each social enterprise seeks to understand the process and result of its work[16].

Social performance indicators are determined on the basis of economic and statistical reporting data, based on the results of a survey, using the method of expert assessments, and others. At the same time, some of the indicators have a very conditional value, while others cannot be expressed quantitatively.

Based on the existing traditional assessment methods, we propose to introduce and use an integral coefficient (KEF) to assess the effectiveness of a social enterprise, which includes a set of criteria (K_{1-n}), that is an indicator of the social effectivness of the social project, the effeciency of a social enterprise; the Weisbrod social index, which reflects "the relationship between the types of financial receipts of an enterprise and the nature of the services it provides or the products it produces"; coefficient of social profitability; payback period of a social project, etc.[17]:

$$Kef = K_1 \ast i_1 + K_2 \ast i_2 + K_3 \ast i_3 + K_4 \ast i_4 + K_n \ast i_n, \quad (1)$$

[15] Ageenko A.V. The problem of assessing the satisfaction of the population with the quality of social services for the purpose of managing the quality of life in municipalities // Economics, management, finance:– 2011

[16] Martin, R. L., & Osberg, S. Social entrepreneurship The case fordefinition. Stanford social innovation – 2007.

[17] Catherine L.H. Canadian Social Enterprises: Who Gets the Non-Earned Income?-2016

there $i_{1-4, n}$ – coefficient significance.

As one of the most important criteria for evaluating the effectiveness of a social project, we take the indicator of the social effect from the implementation of a social project K_{SP}), which, based on the methodology for evaluating the effectiveness of an investment project with a social focus, can be calculated using the formula:

$$K_{SP} = K_{RE} * K_{SE}, (2)$$

there K_{RE} –**coefficient of regional usefulness**

K_{SE} – **coefficient of social efficiency**

Social efficiency implies a positive impact from the implementation of a social project for the population, which can be expressed in improving the quality of life or increasing the supply of new social services, in the regularity, timeliness, and also in increasing the availability of their provision.

Conclusion. In the modern civilized world, the assessment of social results and effects obtained in the process of implementation social projects in social organizations, becomes essential elements of their relationship with employees and volunteers, donors, beneficiaries and the state. That's why the community of social entrepreneurs interested in eliminating the main problems along the way development of a unified system for assessing social results and effects. Here is a list of them:

➢ lack of simple and practical tools that causes irregular assessment of social results and effects by social entrepreneurs;

➢ underestimation of the quality of life changes beneficiaries or society;

➢ false goals and indicators: the choice of more "light" beneficiaries to provide services for the purpose demonstrating great success in achieving social results;

➢ proportionality and balance: efforts, invested in the social performance measurement system and the level exactly must be proportionate;

➢ excessive bureaucracy: a system for measuring social results should help, not take away from the social entrepreneur already scarce resources;

To conclude it is necessary to change the attitude towards the evaluation of all internal and external stakeholders interacting with social projects. Social impact assessment is extremely important aspect of the development of social entrepreneurship, which means a way of solving or mitigating the problems that exist in society.

References

1. Ageenko A.V. The problem of assessing the satisfaction of the population with the quality of social services for the purpose of managing the quality of life in municipalities // Economics, management, finance: Collection of conference materials. – Perm: Mercury, 2011. – 123 p. – P. 5-8.

2. Минаев А.В. Критерии и методы оценки проектов социального предпринимательства //– 2011. – Т. 3. – № 3. – С. 153-158.

3. Синдяшкина Е.Н. Вопросы оценки видов социального эффекта при реализации инвестиционных проектов // Проблемы прогнозирования. – 2010. – № 1. – С. 140-147.

4. Catherine L.H. Canadian Social Enterprises: Who Gets the Non-Earned Income?- 2016

5. Рождественская Н.В., Богуславская С.Б., Боброва О.С. Оценка эффективности проектов некоммерческих организаций, социального предпринимательства 2016.-168 с.

6. Васильева М. Сеть пансионатов для пожилых «Опека» собирается продавать франшизу в регионах *Электронный ресурс+ // Портал «Новый бизнес:

социальное предпринимательство». – 2015. – 12 ноября. – Режим доступа: http://www.nb-forum.ru/interesting/stories/opeka-idet-vo-franshiz.html

7. Marta Peris-Ortiz, Carlos Rueda-Armengot "Is it possible to measure social entrepreneurship in firms?" – 2015 Spain

8. Петрова В. Фитнес городских улиц // Портал «Новый бизнес: социальное предпринимательство». – 2014. – 4 августа.

9. Кузнецова Е.С., Богданова А.С. Оценка эффективности проектов в сфере государственного и муниципального управления – 2012. – Т. 15. – № 1. – С. 195-198.

10. Anastasia A. Plyukhina, "Improvement of the method for assessment of social enterprises' activity ", - 2016 Moscow

11. Wee-Liang, J.Williams, Teck-Meng. "Defining the 'Social' in 'Social Entrepreneurship': Altruism and Entrepreneurship." The International Entrepreneurship and Management Journal. P. 353-365 – 2005.

12. Enterprising Ideas. What is a Social Entrepreneur? PBS Foundation – 2018.Enterprising Ideas. What is a Social Entrepreneur? PBS Foundation. –2018.

13. Martin, R. L., & Osberg, S. Social entrepreneurship: The case fordefinition. Stanford social innovation Review. – 2007.

14. Фейербах Л. Сущность христианства // Избранные философские произведения. Т.2-. М.:1955- 420 с

15. Vilensky P.L., Livshits V.N., Smolyak S.A. Evaluation of the efficiency of investment projects theory and practice. Moscow: - 2002. 888 p.

16. Viscisi, W. Kip, Aldy Joseph E. The Value of a Statistical Life: A Critical Review of Market Estimates Throughout The World // Journal of Risk and Insuarance - 2003. V. 27, N. 1, P. 5--76.

ANALYSIS OF THE MANAGEMENT AND DEVELOPMENT OF ENVIRONMENTAL SOCIAL ENTREPRENEURSHIP IN UZBEKISTAN

NARZULLAEV ELMUROD

Doctoral student of Namangan Institute of Engineering and Technology
E-mail: narzullaevelmurod@gmail.com, phone.: (+99891) 363-61-61

Abstract:

Objectives: The main objective of this study is analyzing and measuring the capability of improving and developing social enterprises in Uzbekistan. The theoretical basis of the scale is supported by empirical research in the social sector. On other hand, finding out both strengths and weaknesses on managing and developing environmental social entrepreneurship in our country also was our main aim in this article.

Methods. In this article we used SWOT analysis in order to identify the current condition of environmental social entrepreneurship in Uzbekistan. Besides that, variety kinds of tables and diagrams also created by author based on the information given by statistic committee.

Results. The results of this study analyses that social enterprises are required to report on the social and/or environmental benefits they bring to society, but in most countries, a uniform reporting form and criteria have not yet been developed in the area of control. In foreign practice, there are different definitions of social entrepreneurship, which sometimes contradict each other. According to experts, the complexity of developing a single legal approach to defining the term social entrepreneurship is explained by the following circumstances.

Conclusion. To conclude, environmental social entrepreneurship can be seen as an integral part of every single society and government future plans because of it vitalness and importance in today's world. Because, tons of environmental and social problems are improving day by day instead of reducing. In order to sovle aforementioned problems, social entrepreneurship is a most accurate choice in developing countries like Uzbekistan.

Introduction. In today's rapidly progressing and competitive world, more and more entrepreneurs are working at the intersection of philanthropy and commerce, innovation and traditional business practices to solve social problems in the world. Nevertheless, the legal aspects of the development of the phenomenon of "social entrepreneurship" are still in their initial stages.

The non-existence of the legal space of social entrepreneurship leads to negative consequences, such as the lack of development of rules for granting privileges and preferences, difficulties in buying and renting buildings, problems related to the sale of products, etc. Such difficulties are felt especially in the CIS countries, which pay special attention to social entrepreneurship.

In this regard, the study of the main trends in the field of legal regulation of social entrepreneurship in advanced countries such as the United States, Great Britain, Italy, Malaysia, and South Korea allows the following main points to be distinguished.

Methods. In order to develop social entrepreneurship plenty of works are doing step by step in Uzbekistan. Development of entrepreneurship, creation of new jobs, provision of employment of the population and increase of its income are considered to be one of the priority tasks in the current complex conditions. In this regard, our state and government are taking necessary measures to stabilize the economy and support business representatives.

Therefore, the coronavirus pandemic has shown that it is a very important and urgent task to develop production, increase the number of business entities, and especially to prevent a sharp decrease in the income of the low-income and unemployed segments of the population in order to increase the income of the population.

Today, it is an important task to introduce and develop non-state social protection policy, i.e., social entrepreneurship, taking into account international experiences and new approaches to solving socially important issues. Therefore, the draft law "On Social Entrepreneurship" defining the legal basis of the industry was developed.

The faction of the People's Democratic Party of Uzbekistan in the Legislative Chamber of the Oliy Majlis, among a number of issues on the agenda, this draft law was discussed in the second reading with the participation of deputies and representatives of official organizations. This draft law, discussed by the members of the faction, includes concepts such as the main principles of social entrepreneurship, the main directions of its activities, types of activities, and the main directions of the state policy in the field of social entrepreneurship[18].

According to the draft law, new forms of state support for social entrepreneurship are being adopted to identify enterprises that have directed their resources to the social sphere, to take into account the privileges and

---

[18] O.Otaxanova Can social entrepreneurship solve social problems in society? – 2020

preferences given for attracting investment into the social sphere.

In the project, based on their social importance, the persons belonging to the socially needy categories of the population are listed[19]:

• Persons with group I and II disabilities, children with disabilities;

• orphans and children deprived of parental care and persons aged 18 to 30 who belong to their category;

• persons suffering from socially significant diseases and diseases that pose a danger to others (tuberculosis, oncology, AIDS, leprosy and occupational diseases);

• single persons with dependent children under the age of 16 or with disabilities;

• graduates of general secondary, secondary special and professional educational organizations within 3 years of graduation;

• Graduates of orphanages under the age of 30;

• persons released from prisons;

• single elderly people who need the care of others and elderly people living alone;

• incompetent and disabled persons.

Forms of state support for social entrepreneurship social entrepreneurship activity by the state support is provided in the following forms[20]:

a) providing benefits and preferences;

b) subsidizing social project costs;

c) placement of the state social order;

d) financial support;

e) training and retraining of social enterprise employees

f) providing advice, methodical assistance and informational support.

State support of social entrepreneurship activities is implemented from the day the business entity is entered into the register of social enterprises and is canceled from the day it is removed from the register of social enterprises.

State support for social entrepreneurship activities is applied to business entities that have changed their main activity in order to eliminate emergency situations only during the emergency period and is canceled from the first day of the month following the month in which the emergency situation was eliminated (cancelled).

Results. In accordance with the current legislation, tax and other benefits are established for enterprises that produce products and equipment for people with disabilities. However, the legal concept of social entrepreneurship and the mechanisms of legal regulation of relations related to it are not clearly provided for.

In this regard, when studying the legislation of the USA, Great Britain, Poland, Belgium, Italy and other countries, it can be seen that as a result of the establishment of this entrepreneurial activity, a high result has been achieved in terms of the production of social goods and the provision of social services, along with providing employment to the socially vulnerable sections of the population.

From this point of view, it was necessary to adopt the law "On Social

---

[19] pf-26 on amendments and additions to certain documents of the president of the republic of Uzbekistan in connection with the improvement of the system of social support for the elderly and people with disabilities–2021

[20] draft law on social entrepreneurship 17th substance

Entrepreneurship" in our country. Its main goal is to improve the living standards of the socially vulnerable population, provide them with work, produce social goods and provide services.

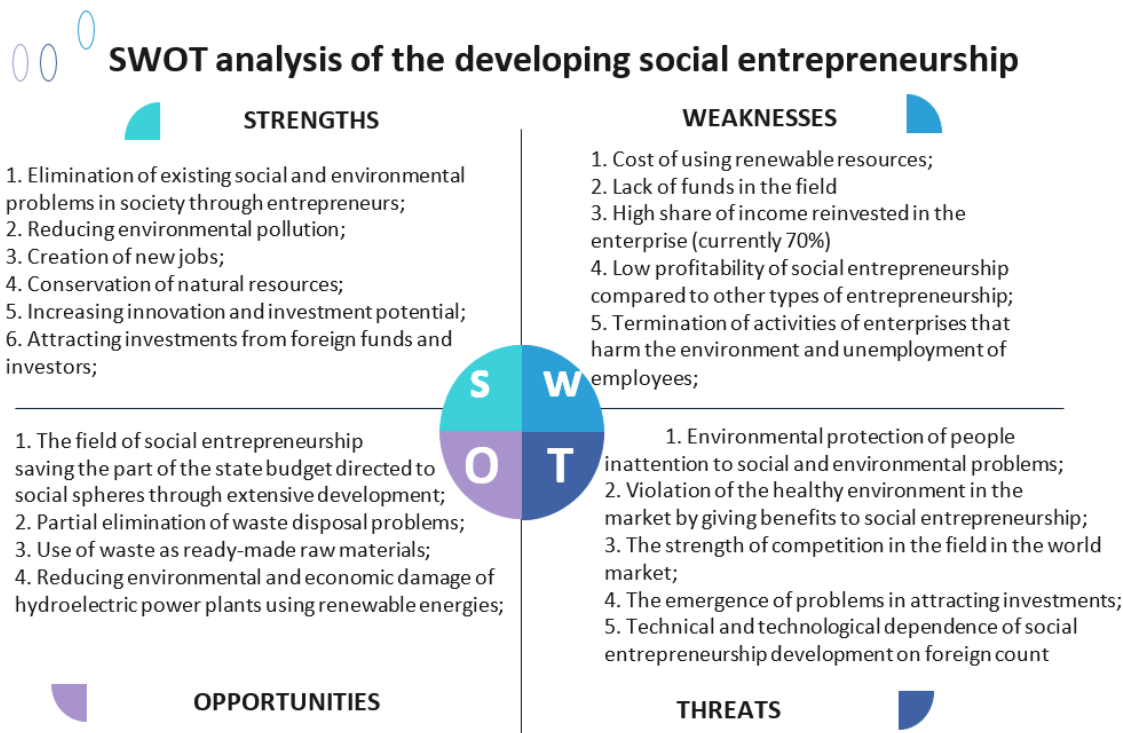To analys current condition of SE in Uzbekistan more properly we utilized SWOT analysis.

Figure 1. SWOT analysis of the developing social entrepreneurship[21]

It can be transparently seen that there are huge opportunities to develop SE in Uzbekistan which brings plenty of possitive effects to economy and environment. But, it is fair to say that SE does not come with negative affects like termination of activities of enterprises that harm the environment and unemployment of employees or violation of the healthy environment in the market by giving benefits to social entrepreneurship. From our point of view, SE has more advantages than its disadvantages. With the help of SWOT analysis we were able to find out external and internal factors which affects and effects social enterprices. (Figure 2)

In the development of social entrepreneurship aimed at environmental protection, it is important to study the specific features of the environment affecting the industry and the interdependence of their constituent factors. Although external and internal factors affecting the development of social entrepreneurship based on environmental protection have not been systematized in the Republic of Uzbekistan, much attention is being paid to the greening of the economy. External factors affecting development do not depend on the social enterprise itself, these factors require support from the government and cooperation with other sectors.

Among the external factors, environmental factors and problems related to environmental damage in the country, as well as the socio-cultural level of the population occupy an important

---

[21] Created by author

place. The creation of a favorable investment environment ensures the attraction of foreign investors in solving existing environmental problems and the study of foreign experience through them. The most important external factor in the development of social entrepreneurship is the government's support of the industry, which creates benefits for entrepreneurs and focuses on increasing their skills.

Internal factors also have a direct impact on the development of social entrepreneurship aimed at environmental protection. These factors mainly depend on the skills of the social entrepreneur, such as his experience, level of understanding of the field, mastery of social entrepreneurship activities, thoroughness of the business plan, and the potential to use resources and modern technologies. In addition, the social and material benefit of entrepreneurs and how much of the income they can reinvest and how much they can use as they wish is the reason for the development of social entrepreneurship aimed at environmental protection by encouraging entrepreneurs.
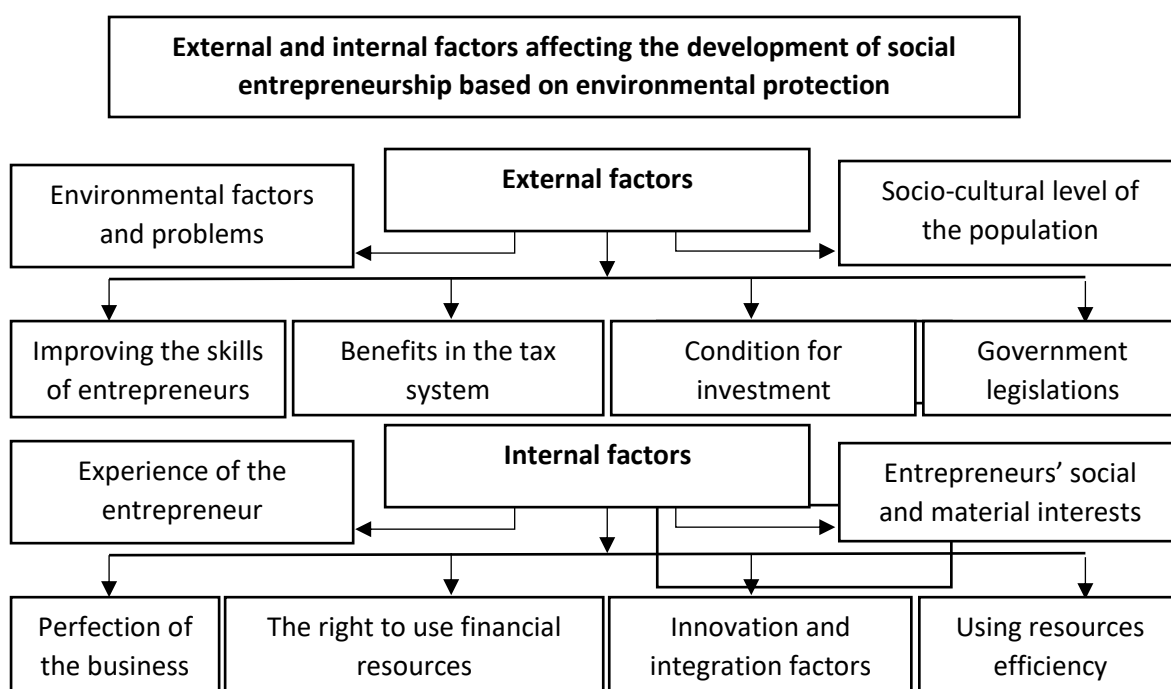
```
┌─────────────────────────────────────────────────────────────┐
│ External and internal factors affecting the development of    │
│ social entrepreneurship based on environmental protection     │
└─────────────────────────────────────────────────────────────┘

┌──────────────────┐   ┌──────────────────┐   ┌──────────────────┐
│ Environmental     │   │ External factors │   │ Socio-cultural    │
│ factors and       │   │                  │   │ level of the      │
│ problems          │   │                  │   │ population        │
└──────────────────┘   └──────────────────┘   └──────────────────┘

┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ Improving    │ │ Benefits in  │ │ Condition    │ │ Government   │
│ the skills   │ │ the tax      │ │ for          │ │ legislations │
│ of           │ │ system       │ │ investment   │ │              │
│ entrepreneurs│ │              │ │              │ │              │
└──────────────┘ └──────────────┘ └──────────────┘ └──────────────┘

┌──────────────────┐   ┌──────────────────┐   ┌──────────────────┐
│ Experience of the │   │ Internal factors │   │ Entrepreneurs'    │
│ entrepreneur      │   │                  │   │ social and        │
│                   │   │                  │   │ material interests│
└──────────────────┘   └──────────────────┘   └──────────────────┘

┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ Perfection   │ │ The right to │ │ Innovation   │ │ Using        │
│ of the       │ │ use financial│ │ and          │ │ resources    │
│ business     │ │ resources    │ │ integration  │ │ efficiency   │
│              │ │              │ │ factors      │ │              │
└──────────────┘ └──────────────┘ └──────────────┘ └──────────────┘
```

Figure 2. External and internal factors affecting the development of social entrepreneurship based on environmental protection[22]

Conclusion. In conclusion, it should be noted that in the context of the decrease in the rate of economic growth in the world and the socio-economic consequences of this trend have grown to an unforeseeable level, the governments of developed and developing countries are working to create legal foundations for social entrepreneurship. they give priority to the development of effective measures.

From this point of view, in the conditions of the Republic of Uzbekistan, the development of normative frameworks for the creation and development of the institution of social entrepreneurship, which provide for the system of full support by the state, including the announcement of

---

[22] Created by author

subsidies and grants for them, benefits and it will be appropriate to provide preferences, as well as provide constant advisory support.

It is also important to take measures to inform the public and business circles about the benefits of social entrepreneurship.

References

1. Enterprising Ideas. What is a Social Entrepreneur? PBS Foundation.19.06. 2018.

2. J. Gregory Dees. The Meaning of Social Entrepreneurship . CASE at Duke (31 October 1998). 31 July 2016.

3. Thompson, J.L., The World of the Social Entrepreneur, The International Journal of Public Sector Management, 15(4/5), 2002, p.413

4. Жохова, 2015, с. 83—84. Примечания

5. Кикал, Лайонс, 2014, с. 139—140.

6. Борнштейн, 2015, с. 30.

7. Martin, R. L., & Osberg, S. (2007). Social entrepreneurship: The case for definition. Stanford social innovation review, 5(2), 28-39.

8. Wee-Liang, Williams, John, and Tan, Teck-Meng. «Defining the 'Social' in 'Social Entrepreneurship': Altruism and Entrepreneurship.» The International Entrepreneurship and Management Journal. no. 3 (2005): 353—365.

9. Sarah H. Alvord, David L. Brown, Christine W. Letts. Social Entrepreneurship and Societal Transformation: An Exploratory Study // The Journal of Applied Behavioral Science. — 2004. —№ 3. — С. 260—282.

10. Мартин, Осберг, 2018, с. 24.

11. David P. Baron. Corporate Social Responsibility and Social Entrepreneurship // Journal of Economics & Management Strategy. — 2007. — № 3. —Р. 683—717.

12. Кикал, Лайонс, 2014, с. 9.

13. Bornschtein, 2015, с. 32.

14. O.Otaxanova Can social entrepreneurship solve social problems in society? – 2020

15. pf-26 on amendments and additions to certain documents of the president of the Republic of Uzbekistan in connection with the improvement of the system of social support for the elderly and people with disabilities–2021

16. Draft law on social entrepreneurship 17th substance

LEGAL REGULATION OF ENTREPRENEURIAL ACTIVITY

BAYBOBOEVA FIRUZA

Doctor of Philosophy in Economics (PhD)
of Namangan institute of engineering and Construction
E-mail: firuzanabijonovna@mail.ru, phone.: (+99890) 555-55-30

Abstract:

Objective. The Economic Association of Interaction - individuals or legal entities, in order to combine the wines to maintain their independence, and the combined facilities. Corporation - for, to work in partnership to achieve common goals, united, independent legal entity - a legal person, the person described in the amount of medication. They are created in the form of joint stock companies. The concentration of enterprises is carried out in the form of cartel, syndicate, holding and financial-industrial groups.

Methods. In the process of analysis, methods of comparison and systematic analysis were used. The state of ensuring the development of sustainable development was assessed by the monitoring method and the corresponding conclusions were formed through abstract-logical thinking.

Results. The selection of the best forms of communication between the factors under consideration plays an important role in the effective modeling of data on the processes of ensuring the security of small business and private entrepreneurship by methods of correlation-regression analysis. In this article, we give examples of a system of normal equations generated by the least squares method to determine the mathematical models often used and the unknown parameters in the models and its application in practice.

Conclusion. The concept of security should firstly, meet the environmental goals and objectives of the enterprise and secondly, to consider external effects on the environment that may have a direct or indirect impact on the safety of the enterprise. At the same time, the company's work is critical for some measures to ensure the safety of the accused should be done, and, above all, for the appropriate reserve should confirm the creation order.

Keywords: production, goods, working capital, fixed assets, national economy, funds, economic activity, economic stability, quality enterprise, business, method, mathematical model, economic security, coefficient of variation, confidence interval.

Introduction. The Economic Association of Interaction - individuals or legal entities , in order to combine the wines to maintain their independence, and the combined facilities. Corporation - for, to work in partnership to achieve common goals, united, independent legal entity - a legal person, the person described in the amount of medication. They are created in the form of joint stock companies. The concentration of enterprises is carried out in the form of cartel, syndicate, holding and financial-industrial groups. Schedule of production problems in the production of characters, prices, sales of goods, labor issues, such as recruitment and acts on the basis of the contract. In this form of integration, enterprises are united on the basis of cooperation, while maintaining their independence. Syndicate of commercial activity (supply, sale, and pay the price to do), which will be organized on the basis of the association is. Within the framework of the syndicate, enterprises retain their legal and economic status. Trest are highly centralized. His enterprises lose production, trade and independence and operate according to a single plan. Holdings are an effective form of management that allows you to consolidate and coordinate the financial resources of participants, as well as quickly perform production tasks.

These enterprises will be engaged in integration processes in order to:

• Achieving a more efficient use of resources;

• Updating and strengthening cooperation through cooperation;

• Access of entrepreneurs to foreign markets;

• Attracting new types of investment in production;

• Pursuing a unified pricing and sales policy to achieve success in the domestic and foreign markets.

Methods. In the process of analysis, methods of comparison and systematic analysis were used. The state of ensuring the development of sustainable development was assessed by the monitoring method and the corresponding conclusions were formed through abstract-logical thinking.

Results. N.V. Matveev offers the following definition of economic security of an enterprise: "this is the state of the enterprise, which ensures the stability of its functioning, financial equilibrium and regular profit-making, the ability to fulfill set goals and objectives, and the ability to further develop and improve".

Alshanskaya T.V., Kazhaeva Yu.D. and Mironenko A.V. offer a classification of security threats that can

be implemented by dividing into threats related to internal and external factors. Security threats - internal - external - random - intentional. The purpose of ensuring the economic security of the enterprise is to protect its property and employees from sources of external and internal security threats, to prevent the causes and conditions that give rise to them. For each enterprise, "external" and "internal" threats are purely individual (industry-specific, scale of the enterprise, field of activity). At the same time, in our opinion, these categories include individual elements that are acceptable to almost any business entity.

The selection of the best forms of communication between the factors under consideration plays an important role in the effective modeling of data on the processes of ensuring the security of small business and private entrepreneurship by methods of correlation-regression analysis. In this article, we give examples of a system of normal equations generated by the least squares method to determine the mathematical models often used and the unknown parameters in the models and its application in practice. When choosing the form of the regression equation, the following should be considered:

1. The general form of the connection, the nature of the connection should be consistent with the characteristics of the control object being studied.

2. Whenever possible, use the simplest forms of equations that are easy to interpret and apply.

As a regression equation, it is often linear:

$$\hat{y} = a_0 + a_1 x_1 + a_2 x_2 + ... + + a_n x_n \quad [5]$$

and level functions are used:

$$\hat{y} = a_0 x_1^{a_1} x_2^{a_2} ... x_n^{a_n} \quad [6]$$

The parameters of this equation are usually determined by the least squares method. In general, the system of normal equations is expressed as follows:

$$\begin{cases} na_0 + a_1 \sum x_1 + a_2 \sum x_2 + ... + a_n \sum x_n = \sum y \\ a_0 \sum x_1 + a_1 \sum x_1^2 + a_2 \sum x_1 x_2 + ... + a_n \sum x_1 x_n = \sum x_1 y \\ .... \\ a_0 \sum x_n + a_1 \sum x_1 x_n + a_2 \sum x_2 x_n + ... + a_n \sum x_n^2 = \sum x_n y \end{cases}$$

The bond density is similar to the correlation index and is estimated using the cumulative correlation coefficient:

$$R_{yx_j} = \sqrt{1 - \frac{\sum \left(y - \hat{y}\right)^2}{\sum \left(y - \bar{y}\right)^2}} \quad [8]$$

where, $\hat{y}$ is the theoretical value of the resulting index determined using the regression equation; $\bar{y}$ - the arithmetic mean of the resulting figure.

Multidimensional mathematical models of the degree of dependence of GDP on other factors were developed on the basis of statistics on the development of

small business and private entrepreneurship, their equal opportunities in competition and economic security.

The mathematical model u = a0 + a1x1 + a2x2 + a3x3 + a4x4 + a5x5 + a6x6 + a7x7, was sought in the form. Here, it is the gross domestic product (billion soums); x1 - industry (billion soums), x2 - construction (billion soums); x3 -, employment (thousand people); x4 – export (mln.USH.dol); x5 - import (mln. USD); x6 - trade (billion soums); x7 - agriculture, forestry and fisheries (billion soums), a0, a1,…, a7 - constant numbers. To find the coefficients a0, a1,… a7 we use the method of least squares of mathematical statistics. As a result, we create the following mathematical model.

$y = 1174{,}46 + 184{,}84\,x_1 + 78{,}45\,x_2 + 79{,}7\,x_3 + 17{,}9\,x_4 + 37{,}41\,x_5 + 299{,}45\,x_6 + 47{,}7\,x_7.$

The analysis of the mathematical model shows that the influence of industry, trade, agriculture, forestry and fisheries on the factors shaping the potential of the gross domestic product is significant.

Institutional reforms in the oil and gas sector of the country Creation of "Uzbekneftegaz", structural and substantial change in vertically integrated structures in the direction of market relations.[1] Transformation of the state concern into the national corporation Uzbekneftegaz [2] from the creation of NHC "Uzbekneftegaz" It is characterized by a three-stage process consisting of.[3] Of course, as a result of these organizational changes, some enterprises were liquidated, while others received new institutional names. Entered into the existing system of the Company on August 21, 2006.

Discussions. Determining the level of public-legal regulation of business is a very delicate matter. For example, protecting the domestic market is a constant and necessary task for every state. However, the other side of the issue is the extent to which customs restrictions are imposed in order to protect the domestic market.

In particular, a number of countries have imposed trade embargoes on basic foodstuffs. In addition, the activities of businesses related to the provision of services within the country have been suspended. The analysis shows that in times of crisis, there are sharp changes in the trajectory of the dynamics of public regulation of entrepreneurial activity. This will increase the mass influence of the state in a number of sectors of the economy, and thus stabilize the private economy with the help of the state. With the stabilization of economic relations, the influence of the state on the economy is reduced, and in the regulation of economic relations, public law begins to give way to private law, and, of course, this changes the dynamics of public regulation of the economy.[4]

The policy of the state to determine the level and dynamics of public regulation of entrepreneurial activity can be compared to a passenger on horseback. The passenger pulls the reins of the horse slightly on uneven, high and low parts of the road (otherwise, he may fall) and when he goes out on a flat road, he loosens the reins of the horse again. But he never let go of the horse's bridle completely. Because in case of emergencies and other dangers, it will be necessary to

control the horse in a safe direction immediately.

The need for mass legal regulation of entrepreneurial activity

1. Public interest supply and protection	2. Effective and expedient regulation of business activities	3. Implementation of economic policy of the state

Level of mass legal regulation of entrepreneurial activity - specific means and measures of legal regulation that realize the need (purpose) of mass legal regulation of entrepreneurial activity.	Dynamics of mass legal regulation of entrepreneurial activity - determines the level of mass legal regulation of entrepreneurial activity, which varies from imperative to dispositive or from dispositive to imperative.

1-fig. The need for mass legal regulation of entrepreneurial activity

Similarly, in times of crisis and depression and transition, the public influence of the state on entrepreneurial activity is increased, but as the economic processes stabilize, the public influence of the state on entrepreneurial activity is reduced. But entrepreneurial activity cannot be completely exempt from the imperative influence of the state. The study and research of the level and dynamics of mass legal regulation of entrepreneurial activity, the development of proposals and recommendations in this regard is important for the liberalization of relations between the state and the business entity. at the same time, it plays an important role in shaping a modern democratic market economy by maintaining the appropriate influence of the state in business, ensuring the harmony and balance of public and private interests in the relationship between the state and the business entity. Thus, in the context of the coronavirus pandemic and the global crisis, there have been significant changes in the level and dynamics of public regulation of business in countries around the world, including Uzbekistan. In particular, in Uzbekistan during this period there was an increase in the dynamics of public regulation of entrepreneurial activity on some issues, and on some issues the opposite, and thus the state provided a reasonable public-legal influence on entrepreneurial activity on the basis of "manual management".

Conclusion. The concept of security should firstly, meet the environmental goals and objectives

of the enterprise and secondly, to consider external effects on the environment that may have a direct or indirect impact on the safety of the enterprise. At the same time, the company's work is critical for some measures to ensure the safety of the accused should be done, and, above all, for the appropriate reserve should confirm the creation order. The experience of domestic and foreign practice identifies the following areas of activity:

1. Ensure the protection of buildings and structures, communications and equipment.

2. Fast, confidential information and the safety management body, passengers and cargo traffic control, investigate

violations, security information security.

3. Ensure the safety of the administrative officer (workers) in the preparation and training, inspection, audit and measures to prevent rat problems, promising to develop.

4. Protection of material resources and disaster management, fire protection, fire safety and monitoring the status of fire alarm systems, etc.

Company managers must report on the results of continuous labor safety. Only when necessary can security measures be kept confidential. Confidentiality of security measures requires the establishment of special supervision over the application and observance of business rules by business units.

The charter of the Security Service of the enterprise determines its goals and objectives, rights and obligations, control and audit activities. The security service operates on the basis of a high level of security and enterprise support, which includes:

• Organization of confidential events;

• Ensuring information security;

• Engineering and technical protection;

• Measures to prevent negative trends in the workforce.

The company to ensure the safety of its economic indicators, to improve their behavior. This will increase the image of the enterprise. It serves the welfare of society and society.

The trade secrets of the enterprise are related to production, technological information, management, finance and so on. Corporate trade secrets The BBC category features as defined by law.

According to current prospects, business secrets of an enterprise usually include the following:

• Trade relations of the enterprise;

• Capital structure and structure, investment plans;

• Suppliers and customers, contracts;

• Production volume, working capital and profit;

• Assessment of policies and the price of the goods constitute a means of livelihood;

• Banking operations, etc.

In addition to the term "trade secret", the term "trade secret" is also used. It includes information on production methods, technologies, technical inventions, research, labor organization, communications and so on.

Disclosure of today's market relations, especially from the point of view of competitive confidentiality of business and production secrets of the

enterprise, can negatively affect its condition and lead to the loss of consumers of products. According to experts, the loss of a quarter of business data is also an excellent opportunity for competitors, and half of the companies that published the data within a few months may go bankrupt. For this reason, it is advisable to establish a clear legal status and classification of trade secrets and develop a mechanism of responsibility for their disclosure.

Accurate calculation of the total amount of losses is a complex and time-consuming process, and sometimes it is impossible to calculate due to the lack of reliable data. The above requires additional costs from enterprises and reduces their productivity and competitiveness. That is why much attention is now being paid to protecting trade secrets.

Economic security is based on the following principles:

Firstly, it is the freedom to choose activities and forms. Although a "market economy" is a multidimensional concept, its main feature is the freedom of economic activity.

Of course, economic freedom is limited to circles that do not allow it to enter into anarchy and economic independence. Without a system of social constraints, the freedom of some actors can be violent for others, while security should be avoided.

Secondly, the security of any entrepreneur is to choose and choose the type of economic activity that he wants and purposefully.

Security as a precautionary measure for preventing and responding to incidents is a clear step in each individual case, depending on the nature of the enterprise, its location and importance. Security identification is important in this process. Its head of concern security development of certain production conditions should be personally involved in the development. [9]

References

1. Schumpeter J. Theory of Economic Development. –M.: Progress, 1985. –159 p.;

2. Keynes, J. The General Theory of Employment, Interest, and Money. - M.: Economics, 1948. - S. 238-241.;

3. Khizrich R., Peters M. Entrepreneurship or how to start your own business and succeed. –M.: Progress, 1991. - 223 p.; Hayek F. The Road to Dawn –M.: Economics, 1992. - 91 p.;

4. Lapusta M.G., McConnell K.R., Bru S.L. Economics. In 2 t. T-1. - M., 2003.-- 399 p.;

5. Khodiev B.Yu., Kasymova MS, Samedov A.N. Small business and private entrepreneurship. -T.: TUIT, 2010.-26 9. Muftaydinov V. Socio-economic problems of business development. –T.: NUU, 2000. - 37 p;

6. Kulmatov A. Development of small business and private entrepreneurship in Uzbekistan: dissertation. - T. : NUU, 2004 .-- 22 p;

7. Salaev S. Modeling and forecasting small business development trends. Ph.D. ... diss. abstract - T .: TGUU, 2008. - 49 p;

8. Nabijonovna, B. F. (2020). The economic content of small business and entrepreneurship. *International Engineering Journal For Research & Development*, *5*(4), 3-3.;

9. Nabijonovna, B. F. (2020). Business activity and its economic indicators. *ACADEMICIA: An International Multidisciplinary Research Journal*, *10*(3), 151-161;

10. Nabijonovna, B. F. Development of Innovative Entrepreneurial Activity. *JournalNX*, 88-93;

11. Кабилов, Ш., & Байбобоева, Ф. (2020). Развитие предпринимательства как ведущий фактор подъема экономики. *Общество и экономика*, (12), 100-108;

12. Байбобоева, Ф. Н. (2015). Методы привлечения негосударственных инвестиций для развития средне специального образования. *Журнал научных и прикладных исследований*, (8), 21-23;

13. Байбобоева, Ф. Н. (2015). Международный опыт создания эндаумент-фондов. *Научная перспектива*, (8), 50-52.;

ASSESSMENT OF IMPACT OF ARTIFICIAL INTELLIGENCE ON LABOR MARKET AND HUMAN CAPITAL

GOYIPNAZAROV SANJAR

Associate Professor of Tashkent State University of Economics
E-mail: s.goyipnazarov@tsue.uz, phone.: (+99899) 974-48-22

Abstract. In this article, the impact of artificial intelligence technologies on the development of the country's human capital and changes in the labor market is analyzed empirically and econometrically. The research was carried out on the basis of the sociological research method, and the questionnaire was prepared on the basis of the Likert scale. The validity and reliability of the survey options based on the Likert scale is based on the evaluation of its internal consistency. "Cronbach's alpha" coefficient was used to evaluate the internal consistency and reliability of internal consistency of the questionnaire using the IBM SPSS Statistics 22.0 program. As a result of the study, the result of testing the hypothesis that human capital has a positive effect on the state of digital development as a result of the impact of artificial intelligence on the labor market shows that there is a strong relationship between them. It has become clear that the impact of artificial intelligence on the education system can also directly affect the digital development of human capital in the country. It also became known that the healthcare system under the influence of artificial intelligence will have a positive effect on the digital development of human capital.

Keywords: artificial intelligence, digital development of human capital, labor market transformation.

Introduction. In today's "Industry 4.0" era, artificial intelligence can fundamentally change work processes. Another concern is that AI could have a negative impact on the labor market if human capital is not developed to accommodate the new changes. According to scientists, artificial intelligence has the potential to be "the most important general-purpose technology of the present and foreseeable future". However, there is also concern that advances in artificial intelligence could lead to mass automation and job losses.

The question of whether artificial intelligence will complement or replace human labor is an important issue with policy implications. For example, if artificial intelligence replaces human labor, governments may reconsider retraining or digital skills training programs for affected individuals. On the other hand, if AI complements human labor and spurs growth, policymakers may instead support policies to encourage investment in AI.

The introduction of artificial intelligence creates gaps in human capital, which can deprive them of various opportunities and affect productivity. AI also creates the need for governments, organizations and higher education institutions to develop a national-level

roadmap for developing new skills and upskilling to ensure the relevance and competitiveness of human capital.

In many scientific and applied studies, there are mainly two views, some of them evaluate artificial intelligence as a substitute for labor, while others describe artificial intelligence as a complement to human labor. However, there is little systematic evidence on the impact of AI on the labor market. One of the reasons for the lack of evidence is that the rapid development of artificial intelligence is a nascent phenomenon and, accordingly, the appropriate tools and methods to assess its impact have not yet been developed. In order to fill this gap, we consider it appropriate to develop a new approach to assess the impact of artificial intelligence on the labor market and occupations in our research and call it the occupational impact of artificial intelligence. We also aim to explore the impact of artificial intelligence on the digital development of human capital from this evaluation approach.

In order to study these problems, we conducted a questionnaire survey in cooperation with the "Public Opinion Center". The main goal of this study is to more accurately study the impact of artificial intelligence on the labor market and its changes, as well as the development of human capital in Uzbekistan. To achieve the main objective, the following three objectives are critically considered:

- analyzing the relevant impact on human capital in the adoption of artificial intelligence;

- analysis of the impact of the newly developing artificial intelligence technologies on the labor market and changes in professions in it;

- it will be analyzed in which fields and industries artificial intelligence technologies can be introduced more in the near future.

160 respondents took part in this online survey and expressed their attitude to the survey questions. The answers given by the respondents to the survey questions were analyzed, their average statistical value and standard deviation were calculated, and the results were presented in tables and graphs.

Analysis of literature on the subject. Michael Webb, one of the leading researchers in the field, believes that the relationship between artificial intelligence employment and wage growth should be analyzed according to the specific characteristics of different occupations in the labor market. That is, it first considers how AI might affect the relationship between employment and wages in low-, middle-, and high-income occupations, and that this result may affect the polarization of the labor market under the influence of AI[1]. Another economist argues that AI may also affect the labor market through more indirect channels. For example, it can lead to the creation of new products, which can affect the demand for labor, and more effective education, which can affect the supply of labor[2].

Researcher Daniel Schiff and his team believe that the impact of artificial intelligence on the educational system leading to the digital development of human capital can be viewed in two ways. That is, as the impact of artificial intelligence on the education system and the impact of the education system on the development of artificial intelligence. When assessing the impact of AI on the education system, it can be studied from the perspective of AI-based teaching and learning tools in the education system and AI tools used in the management of the education system. Also, the influence of the educational system on the development of artificial intelligence is considered to be possible to deeply study the level of literacy of the population on artificial intelligence, the development of necessary skills for artificial intelligence, and the directions of training specialists in the field of artificial intelligence [3]. Loeks, an economist, also points out that artificial intelligence can be an effective learning tool that reduces the

burden on teachers and students in the educational process and offers an effective learning experience for students. Coupled with current educational reforms such as digitization of educational resources, gamification, and personalized learning experiences, there are many opportunities for the development of AI applications in education. As a result of this, it is believed that the ability of educators to quickly and easily learn modern skills will increase [4].

Artificial intelligence has the potential to transform the efficiency of the healthcare delivery system. The findings of the European Union's EIT Health report explore how AI can help improve patient experience and access to healthcare services. As a result of the study, it became clear that the introduction of artificial intelligence technologies into the healthcare system can increase the efficiency of medical care and enable healthcare institutions to provide more and better care to patients. AI can also improve the experience of medical doctors, allowing them to spend more time directly caring for patients and reduce burnout. artificial intelligence also creates great opportunities for the delivery of online health services to the population. A critical component of these capabilities includes connecting large numbers of patients with artificial intelligence through a variety of automated, easily scalable methods of patient health care, such as text messaging and patient portals.

Research methodology. Research organization includes the following stages: organization (preparation); the process of creating a questionnaire; stage of processing the obtained results; drawing up conclusions based on the results and developing suggestions and recommendations for improving activities.

The research questionnaire was created based on the Likert scale.

According to this method, answers to 5 questions based on 5 parameters (scales) are formed in the following order: "5" - I strongly agree, "4" - I agree, "3" - I am not sure, "2" - I do not agree, "1" - I do not agree at all.

The validity and reliability of the survey options based on the Likert scale is based on the evaluation of its internal consistency. "Cronbach's alpha" coefficient was used to evaluate the internal consistency and reliability of internal consistency of the questionnaire using the IBM SPSS Statistics 22.0 program.

$$\alpha = \frac{N * \bar{c}}{\bar{v} + (N - 1) * \bar{c}},$$

Here, α = Cronbach's alpha coefficient; N = number of studied respondent enterprises; $\bar{c}$ = average correlation of obtained results; $\bar{v}$ = mean difference. Cronbach's alpha coefficient ranges from 0 to 1, and its value is if $\alpha \geq 0.9$, then the internal consistency of the results obtained from each survey is "excellent", if $\alpha \geq 0.8$, "good", if $\alpha \geq 0.7$ indicates "acceptable" if $\alpha \geq 0.6$, "doubtful" if $\alpha \geq 0.5$, and finally "unacceptable" if $\alpha \geq 0.5$. In the study, it was found that this coefficient is equal to 0.82. This means that the statistical reliability of the research is positive. Also, analyzes such as data regression test and hypothesis test were performed using the SPSS tool. The classification of respondents participating in any research questionnaire can be defined as demographic indicators [5], which have the ability to display statistical information based on the information provided by the participants, as it is very important for generalization. The demographic table below shows the demographics of the participants in this study (Table 1).

Table 1.

Demographic information of respondents

Demographic indicators of respondents		Frequency	Percentage
Gender	Эркак	111	70.3
	Аёл	46	29.7
Age group	18-25	30	25.7
	26-35	51	30.8
	36-45	52	31.1
	46-55	13	6.8
	56≤	11	5.6
Field of activity	Public administration	12	7.5
	Construction	4	2.5
	Finance and insurance	20	12.5
	IT	28	17.5
	Production	23	14.3
	Education	55	36.3
	Trade and commerce	15	9.4

The response rate of male respondents to the survey was 70.3% and 29.7% of female respondents. Most of the participants are between 36 and 45 years old (52%), with more than 15 years of work experience (47.5%), which may be closely related to maturity level. Also, it can be emphasized that some participants do not have fundamental knowledge about artificial intelligence and its positive impact on the growth of human capital and its impact on the labor market and professional changes in it.

The questions in the questionnaire are divided into three sections, each section representing the elements that can be affected by artificial intelligence. That is, the first element refers to the labor market and professional changes in it, while the second and third elements consist of variables related to education and health care systems, which are part of human capital. Each independent variable represents the important elements of human capital and implies an assessment of how they can affect the digital development of human capital under the influence of artificial intelligence. The dependent variable in this study is the state of digital development of human capital. For each of the independent variables selected for the study, separate research hypotheses were formulated and these hypotheses represent the research objectives in determining how artificial intelligence can affect the digital development of human capital (Figure 1).

As a first hypothesis, we determined that the impact of artificial intelligence on the labor market and professional changes in it can positively affect the digital development of human capital.

In the second hypothesis, we estimated that the effect of artificial intelligence on the educational system may have a positive relationship with the digital development of human capital.
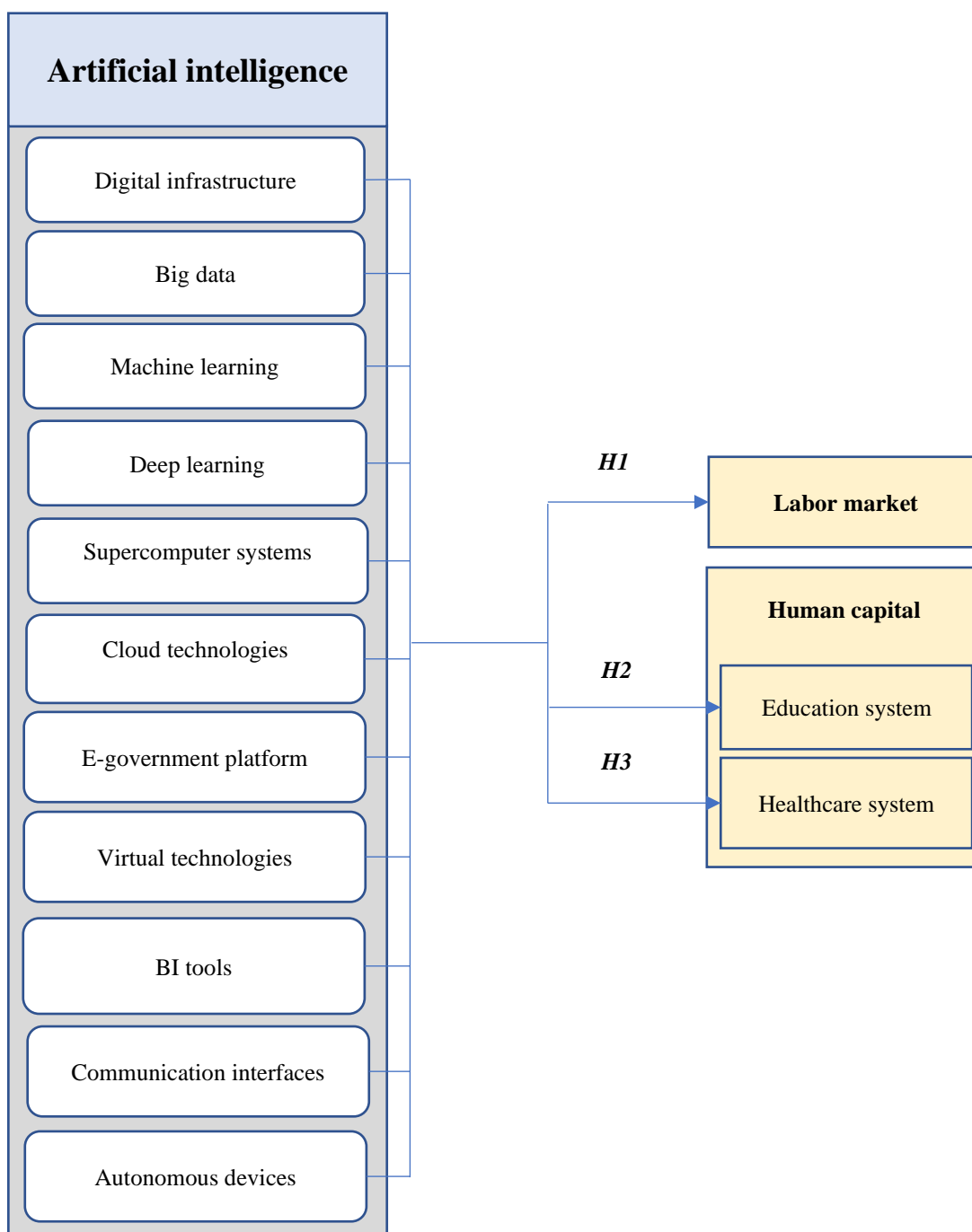
Figure 1. Research hypothesis

And finally, our third hypothesis was that the healthcare system under the influence of artificial intelligence can have a positive effect on the digital development of human capital.

Analysis and results. Thus, Table 2 below describes the descriptive statistics of the econometric evaluation of the impact of artificial intelligence on human capital and the labor market. According to him, the average value of variables close to 4 values and higher values reflected "good" and "high" results.

Table 2.

Descriptive statistics for each construct in the survey

Variables	N	Minimum	Maximum	Mean		Standard deviation
	Statistics	Statistics	Statistics	Statistics	Standard error of the mean	Statistics
Artificial intelligence	157	1	5	4,11	,073	,910
Labor market	157	1	5	3,99	,095	,885
Education system	157	1	5	4,22	,078	,976
Health care system	157	1	5	4,17	,088	,705

This table also shows the standard error of the mean and the standard deviation of the variables. The standard error of the mean measures the precision of the sample mean, meaning that it is designed to approximate it.According to it, the smallest average values of the independent variable (artificial intelligence) and dependent variables (labor market, education system, health care system) are in artificial intelligence (.073) and education system (.078) variables, and these variables average means that their values are measured with greater precision than other variables. These descriptive statistics also describe the standard deviation values, where the standard deviation estimates the variability from the data points to the mean. According to the results of the table, the standard deviation values of artificial intelligence (.910) and education system (.976) variables are smaller than other variables, which means that the data of these variables are more or densely clustered around the mean value. In general, it can be seen that there is a strong correlation between the opinions expressed by most of the respondents.

The content of the questionnaire and the normality of its variables were also checked.

Table 3.

The content of the survey questionnaire and the normality of the variables in it are statistics

Questionnaire sections	Skewness	Kurtosis
The impact of artificial intelligence on the labor market	0.891	2.077
The impact of artificial intelligence on the educational system	0.887	2.579
The impact of artificial intelligence on healthcare	0.897	2.062

The normality of each section of the questionnaire and its variables was determined by "Skewness" (asymmetry aspect) and "Kurtosis" (the location of the data being higher or lower than the normal distribution), which were within ± 3.0 and were within the acceptable range for the study.

Regression analysis of the obtained data also helps to assess the suitability of the developed model. R, R-squared, and adjusted R-squared are

293

estimated using the goodness-of-fit model. This helps to determine the strength of correlation between the variables and the selected model.

Table 4 describes the correlation matrix of the econometric assessment of the impact of artificial intelligence on human capital and the labor market, and the correlation coefficient is a statistical indicator that expresses the degree of linear relationship between variables. Pearson's correlation was used because the measurement unit of the variables was in the interval measurement unit.

Table 4.

Correlation matrix of econometric assessment of artificial intelligence impact on human capital and labor market

		Artificial intelligence	Health care system	Education system	Labor market
Artificial intelligence	Pearson correlation coefficient	1	,740**	,789**	,732**
	p-value		<,001	<,001	<,001
Health care system	Pearson correlation coefficient	,740**	1	,625**	,368**
	p-value	<,001		<,001	<,001
Education system	Pearson correlation coefficient	,789**	,625**	1	,461**
	p-value	<,001	<,001		<,001
Labor market	Pearson correlation coefficient	,732**	,368**	,461**	1
	p-value	<,001	<,001	<,001	

According to the results of the analysis, there is a high and positive correlation between the variables "Artificial Intelligence" and "Healthcare System" (r=0.740 p-value < .001), a high and positive correlation between the variables "Artificial Intelligence" and "Education System" (r=0.789 p-value < .001), a high and positive correlation (r=0.762 p-value < .001) was found between the variables "Artificial intelligence" and "Labor market".

A linear regression analysis of artificial intelligence and health system variables was conducted in the study. In this case, R - .740 means that there is a strong and positive correlation between the variables, R2 - .548 means that artificial intelligence affects the healthcare system by 54.8%, adjusted R - .545 means that the linear regression model is moderately reliable (Table 5).

According to the results of linear regression analysis of artificial intelligence and educational system variables, R is .789, which means that there is a strong and positive correlation between these variables. R2 is .622, which means that the artificial intelligence affects the educational system by 62.2%, and the adjusted R is .620, which means that the linear regression model has medium reliability.

Table 5.

Regression analysis of results

Variables	R	R-squared	Adjusted R-squared	Expected standard error	R squared change
Health care system	,740a	,548	,545	,745	,548
Labor market	,732a	,536	,533	,810	,536
Education system	,789a	,622	,620	,602	,622

According to the results of the linear regression analysis of artificial intelligence and labor market variables, R is .732, which shows that there is a strong and positive correlation between these variables, R2 is .536, which indicates that artificial intelligence affects the labor market by 53.6%, adjusted R – , 533 represents the medium reliability of the linear regression model.

A reliability test was also conducted to check the reliability of the data collected from the survey questions sent to the respondents. Cronbach's Alpha was chosen as the reliability test. According to the test result, Cronbach's α = 0.827, which means that the reliability coefficient of the test is high.

According to the results of the impact of artificial intelligence on the labor market, more than 70 respondents rated the impact of artificial intelligence on the labor market as high and more than 40 respondents rated the impact of artificial intelligence on the labor market as good. The overall evaluation result is 3.99, which means that the impact of artificial intelligence on the labor market is positive and good.

Table 6.

Hypothesis testing and analysis

	Non-standard coefficient		Standard coefficient	t	
	B	Std. Error	Beta		Sig.
Artificial intelligence	1.608	.415		3.873	.000
Labor market	.355	.082	.364	4.314	.000
Education system	.092	.074	.100	1.240	.217
Health care system	.082	.102	0.74	.804	.422

The results on the impact of artificial intelligence on the education system are also described, and in these results, about 80 respondents rated the impact of artificial intelligence on the education system highly. The overall evaluation result is 4.22, which means that the impact of artificial intelligence on the education system is positive and high.

According to the results of the impact of artificial intelligence on the health care system evaluated by the respondents on a 5-point scale, more than 80 respondents rated the impact of artificial intelligence on the health care system highly. The overall evaluation result is 4.17, which means that the impact of artificial intelligence on the healthcare system is positive and high.

As a result of the impact of artificial intelligence on the labor market, the result of testing the hypothesis that human capital has a positive effect on the state of digital development shows that there is a strong connection between them. It has become

clear that the impact of artificial intelligence on the education system can also directly affect the digital development of human capital in the country. It also became known that the healthcare system under the influence of artificial intelligence has a positive effect on the digital development of human capital.

Conclusion. Researchers in the field, Thames and Sheife state that the introduction of artificial intelligence can significantly increase the efficiency of human capital in many ways[6]. Based on the obtained results, it can be said that artificial intelligence has its advantages and disadvantages compared to human capital.

Human capital skills and cognitive abilities are cited as important factors to support the transition process, and if these are neglected, these jobs may be at risk of being lost. It is also difficult to predict the true impact of AI on human capital and labor market changes, as the technology is still developing and the potential impact on jobs remains uncertain.

References

1. Michael Webb. The Impact of Artificial Intelligence on the Labor Market. https://web.stanford.edu/_mww/webb_jmp.pdf.

2. Acemoglu, Daron and David H Autor. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics*. Vol. 4, Part B, , ed. David Card and Orley Ashenfelter, 1043–1171. Elsevier.

3. Daniel Schiff. Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies. International Journal of Artificial Intelligence in Education volume 32, pages527–563 (2022).

4. J. Loeckx, "Blurring boundaries in education: context and impact of MOOCs," *The International Review of Research in Open and Distributed Learning*, vol. 17, no. 3, pp. 92–121, 2016.

5. Roth, P.L. and BeVier, C.A., 1998. Response rates in HRM. OB survey research.

6. Thames, L. & Schaefer, D., 2016. Software-Defined Cloud Manufacturing for Industry 4.0. In: Procedia CIRP, 52. pp.: ISSN 2212-8271, pp. 12 - 17.

EVOLUTION OF MANAGEMENT SCIENCE

NOROV ASROR

Senior teacher of Tashkent state university of economics
E-mail: norovasror1@gmail.com

Abstract: Scientific formation and innovation management are two closely related areas of great importance for the development of modern society. In this article, we consider the stages and foundations of the scientific formation of innovation management, which are the main factors of the development of science and technology. The main stages and role of the scientific formation of innovation management in the modern world are considered in the article. The main stages of the evolution of management science under the influence of different schools and approaches are discussed.

Keywords: Management, management, innovation management, the ability to create wealth in new ways, planning stage, conditions and organization, execution stage, leadership stage, innovation cycle, distance-time aggregates, Classical school, Moral school, Scientific school, Process approach, System approach, Life Cycle Approach, Quantitative Mathematical Approaches, Project Approach, Marketing Approach.

The first stage of scientific formation began in antiquity, when people studied their surroundings and created the first scientific theories. One of the first great scientists was Aristotle, who formulated many theories in various fields of

knowledge. While the development of science slowed down in the Middle Ages, science began to develop actively again during the Renaissance. Important discoveries of that time were the works of Galileo Galilei, Isaac Newton and other scientists.

The second stage of scientific development began in the 19th century and continues to this day. At this stage, science became more organized and systematic. Scientific journals, universities and other scientific institutions were created. Many theories were formed, which are the basis for the development of modern sciences.

However, scientific progress cannot lead to such rapid development of technology and economy without innovative management. Innovation management is a management system that enables organizations to create new products, services and technologies, improve production processes and improve business efficiency.

The basis of innovation management is the innovation process, which includes several stages. The first stage is the formation of ideas. At this stage, the organization collects ideas from its employees, customers and other stakeholders. The second stage is the selection of ideas. At this stage, the organization analyzes the collected ideas and selects those with the greatest potential for implementation. The third stage is concept development. At this stage, the organization creates a new product, service or technology concept. The fourth stage is the development of a prototype. At this stage, the organization creates a prototype of a new product or technology. The fifth stage is testing and analysis. In this phase, the organization tests the new product or technology and analyzes the results.

Successful innovation management requires a well-organized project management system that allows you to control each step of the innovation process. It is also important to have qualified specialists who can effectively manage projects and create new products and technologies.

The first stage of scientific development is ancient Greek science, which arose in the 5th century BC. The main representatives of this period were Aristotle, Plato and Socrates. They were engaged in philosophy, mathematics, astronomy and other sciences. During this period, the logical and methodological foundations of scientific research were developed.

The second stage of scientific formation is medieval science. During this period, science was closely related to religion and philosophy. The main representatives of this period were Thomas Aquinas, Roger Bacon and Ibn Sina. They were engaged in philosophy, medicine, astronomy and other sciences. New research methods such as optics and alchemy were developed during this period.

The third stage of scientific development is modern science. During this period, science separated from religion and philosophy and began to develop independently. The main representatives of this period were Isaac Newton, Galileo Galilei and René Descartes. They were engaged in physics, mathematics, astronomy and other sciences. During this period, new theories and laws were developed, such as the universal law of gravitation, the theory of electromagnetism.

Today, science is developing and improving. It is more specialized and branched. Currently, science plays an important role in the economic development of the country. It is the basis of innovative development and creation of new technologies.

Innovation management is a set of methods and methods that allow management of innovation processes in an organization. It is an integral part of modern management and is the main factor of organizational success. The main tasks of

innovation management are to create new products and services, to optimize business processes and to increase the competitiveness of the organization.

One of the main tools of innovation management is innovation marketing. It allows you to assess market needs and create products and services that are required by consumers. Innovative marketing also makes it possible to determine the competitive advantage of the organization and develop a strategy for promoting products in the market.

Another important tool for innovation management is knowledge management. This allows the organization to retain and use the knowledge and experience of its employees. Knowledge management also enables the organization to generate new knowledge and innovation.

The most serious study of the processes of production renewal and, in general, the impact of new products and new technical and management solutions was carried out at the beginning of the 20th century. Austrian economist Y. Schumpeter first introduced the concept of "innovation" into economic theory. In his "Theory of Economic Development", he defines innovation as any change in order to introduce and use new products, markets and forms of company organization, and he identifies a new type of enterprising entrepreneur, which he calls the "Innovator".

The theoretical justification of the importance of innovation was carried out by the English researcher John A. Hobson (1858-1940). According to him, the real power of an entrepreneur lies in the ability to find new markets, produce new products, and discover new ways of producing products. He called such production a "progressive industry".

Y. Schumpeter's concept was developed by some other Western scientists, in particular, P. Drucker, a leading American expert on management issues, in his book "Innovation and Entrepreneurship". "Innovation," he notes, "is a special tool for entrepreneurs who use change as an opportunity to create a new type of business or service." Thus, if Y. Schumpeter theoretically justified the importance of innovation for the firm. competition, that is, for market competition based on scientific and technical achievements, P. Drucker directly shows the importance of innovation for business development.

"Innovations", - writes P. Druker, - are "superstars" of entrepreneurship, based on new knowledge. Such innovations become the object of attention and bring great benefits. Innovations must be market oriented and driven by market conditions. There is only one way to survive in times of economic shocks - this is to turn to business management. (implementation of a systematic organizational structure, long-term planning, application and control of management information). Innovation can be successful if it is supported by concentrated and coordinated efforts by all stakeholders. Briefly, these lines contain accumulated knowledge in the field of innovation process management.

The search for innovative opportunities in real economic conditions for the implementation of a specific innovative project and the formation of their effective combinations essentially represents an innovative strategy at the level of the company implementing the innovative project.

In most economic literature, there are certain differences in approaches to defining the concept of innovation. According to Y. Schumpeter's theory, economic changes are caused by "innovations". It is clear that innovation is not the same as invention. Technological factor, and innovation is an economic and social phenomenon. "Innovation is a category of entrepreneurial activity, in the sense that existing productive forces are used to solve new problems," Schumpeter said. From a technical point of view, rationalization always leads to the emergence of a new "production function"

associated with the emergence of advanced enterprises. In his opinion, new technology cannot be implemented within old enterprises. "Old" firms can survive severe economic shocks only by abandoning conservatism and radically changing under the influence of innovation.

P. Drucker largely agreed with Schumpeter, innovation is not a technical, but an economic concept, which implies changes at all levels of management, that is, management within the enterprise, production and personnel management. He calls innovation "the ability to create wealth in new ways." Thus, in his opinion, innovative activity is practically focused only on issues of production and marketing management, that is, essentially limited to economic aspects, at the same time, the development of innovation and scientific research are of decisive importance for technological progress for economic growth.

In market relations, the connection between capital accumulation and technology is so close that one process cannot be separated from the other, since the use of capital in an embodied form ensures the growth of commodity production.

The evolution of management theory and practice took place in the conditions of scientific and technical progress and the intense evolution of the external environment. The main stages of the evolution of management science under the influence of different schools and approaches are given in table 1.1.

Table 1.1

The main stages of the evolution of the science of management under the influence of different schools and approaches

Schools and approaches of management	Period, year						
	+1885	1920	1930	1940	1950	1960	Currently
Classical School of Management	➡️ (to ~1945)						
Moral school	➡️ (to ~1955)						
Scientific school	➡️ (to ~1925)						
Process approach	➡️ (to Currently)						
Systematic approach	➡️ (to ~1930)						
A life cycle approach	➡️ (to ~1930)						
Quantitative mathematical approaches	➡️ (to ~1930)						
Social-psychological approach	➡️ (to Currently)						
Project approach Marketing approach	➡️ (to ~1930)						

Knowledge and methods of various schools were used in innovative management, and the management process relied on both theoretical concepts of management and various theoretical schools and scientific approaches.

This is explained by the high complexity and less determination (groundedness) of the management object. In fact, it was necessary to develop an algorithm for the proper management of scientific, technical, technological, social and mixed systems.

Management as a science is an interdisciplinary study that uses a wide variety of methods from sociology, psychology, logic, pedagogy, science, mathematics and cybernetics, various technical and economic sciences.

The evolution of management science is based on the enrichment of the content and principles of management, as

well as the improvement of its tasks, methods and ways.

Therefore, the need for innovative development of the economy imposes new requirements on the content, methods and forms of organizing management activities. In this regard, a unique type of management - innovative management - appeared.

President of the Republic of Uzbekistan Sh.M. Mirzieyov said: "Innovation means the future, If we start building our great future today, we should start it on the basis of innovative ideas and an innovative approach," he said in his lectures.

According to the teachings of N.Q. Yoldoshev and U.Sh. Yusupov, "Innovative management is a set of principles, methods and forms of managing innovative processes, innovative activities, organizational structures and their employees engaged in these activities."

According to H.M.Abdusattorova, innovations can belong to the sphere of production, economic, legal and social relations, science, culture, education and other spheres.

Vorabev V.P. and other authors "Innovation management is an independent field of economic science and professional activity aimed at forming and achieving innovative goals by any organizational structure through the rational use of material, labor and financial resources." - expressed their opinion.

V.R. Vesenin "Innovation management, that is, innovation as its object is the process of scientific research, practical development, creation of experimental samples and introduction of new products into production." - considered.

O. Yu. Zhukovskaya said, "Innovation management is the management of changes leading to the improvement of the competitiveness of the enterprise and its products, the management of development based on innovations.

From the point of view of the systemic approach, innovative management is a control system of management (in Greek - a whole consisting of parts), which consists of two subsystems: management (subject of management) and managed (object of management). The relationship between the subject and the object of management is carried out through the transmission of information, which (the process of dissemination and transmission of information) is the process of management. - gave an understanding.

Various concepts and approaches to innovation management as a science are given in table 1.2.

The evolution of management science is based on the enrichment of the content and principles of management, as well as the improvement of its tasks, methods and ways.

table 1.2

Classification of concepts and approaches in innovation management

Basic, basic approaches and concepts	Forms of their implementation and results
Classical school	
1. Principles of division of labor.	1. Discipline.
2. Generality of purpose and leadership.	2. Order.
3. Authority and responsibility.	3. Justice and reward.
4. The ratio of centralization and decentralization.	4. Efficiency.
5. Vertical chain of management	5. Subordination to the main purpose of the company

300

Basic, basic approaches and concepts	Forms of their implementation and results
Moral school	
1. Focus on human resource. 2. Formation of the organization taking into account the uniqueness of interpersonal relations. 3. Regulation of employees' behavior through needs, interests, wealth. 4. Reasons for titling employees	1. More effective use of the potential of employees. 2. Increase productivity. 3. Increasing employee satisfaction. 4. Flexible system of rewards and incentives
Scientific school	
1. Using the analysis of management activities and tasks. 2. Selection, training and placement of employees.	1. Creating conditions for proper operation. 2. Increasing labor productivity.
Process approach	
1. Understanding management as a process. 2. Analysis of factors affecting the process. 3. Management process as a system of interrelated tasks. 4. The role of coordinating command and control tasks	1. Flexibility, continuity and intensity of management. 2. Development of management tasks and coordination. 3. Interdependence of management methods and complement each other. 4. Increasing the efficiency of management decisions.
Systematic approach	
1. Consideration of management as a complex hierarchical social-economic-economic and scientific-technical system. 2. Analysis of the external and internal environment of the system. 3. Dividing the system into managing, managed providing and service providing systems. 4. Separation of scientific and technical and "human" organizers from the system 5. Taking into account the effects of direct, reciprocal relations, mutual cooperation and mutual understanding. 6. Application of the theory of expectations.	1. The rationality of the ways and methods of influence, compatibility of the manager's tasks. 2. Application of synthetic and based decisions based on analysis. 3. Increasing the effectiveness of management decisions and their effectiveness. 4. Manual of technical, socio-psychological, econometric, ergonomic and other methods. 5. Agility, flexibility and harmony to the requirements and goals of the organization. 6. Deep job satisfaction and self-reflection to achieve self-realization.
A life cycle approach	
1. Review of the life cycle of the organization as a social organism. 2. Learning the stages of life cycles. 3. Determining critical points of development. 4. Forecasting and planning based on life cycles. 5. Determining transition trends	1. Clear planning, coordination and leadership. 2. Increasing the manager's awareness and efficiency. 3. Making more accurate and appropriate decisions. 4. It is possible to develop an effective strategy.

Basic, basic approaches and concepts	Forms of their implementation and results
	5. To predict the growth of the company's business and to find ways of comprehensive development and penetration of new markets.
Quantitative mathematical approaches	
1. Application of econometric models. 2. Application of production task equipment. 3. Application of multiple regression (backward) methods according to the "cost-effectiveness" method. 4. Application of stochastic (probabilistic) models.	1. High accuracy, efficiency and quality of management decisions. 2. Selection of priorities for company development. 3. Accuracy of calculations of economic efficiency of production activity. 4. Eliminating uncertainty of results, reducing risks
Project approach	
1. Organization of development, implementation and commercialization of innovative project-type innovations. 2. Project business planning 3. Analysis of the project. 4. Project evaluation 5. Organization of innovative project financing	1. A special type of strategic planning, selection of necessary production-technical and marketing measures. 2. Research on innovation, its consumption and value indicators Multi-step events. Researching resource, technological and financial possibilities. 3. Technical-economic, planning, commercial, environmental and financial transfer based on balance sheet and cash flow. 4. Evaluation of financial stability and commercial efficiency of the project. Calculation of payback period, profitability index, net discounted income and internal rate of return, consideration of risks. 5. Determining the need for financing, finding sources and organizing cash flows under the project.
A marketing approach	
1. Focusing on the marketing strategy of the innovative firm. 2. Specific strategies of innovative marketing: development of competitive advantage strategy, import substitution, cost leadership, penetration of new markets, etc. 3. Development of a strategy for introducing new products into the market. 4. Operational tactical innovative marketing. Choosing the type of marketing. 5. Forecasting and planning of marketing	1. Directing the activities of the firm, its systems and employees to the commercialization of news, taking into account the requests of the future consumer. 2. Naming research of the market. Market condition analysis and forecasting. A study of market capacity, structure and segmentation. Research and forecasting of demand, competitor behavior, types and forms of competition. 3. Determining the purpose, option and time of entering the new product into the

Basic, basic approaches and concepts	Forms of their implementation and results
expenses and income.	market. Development of activities and stages of deployment of news. 4. Development of specific measures for introducing new products into the market. Creative, conversion, incentive and other types of marketing activities. Formation of sales channels. Advertising company, exhibitions, presentations, trial and direct sales, service and warranty service, etc. organize 5. Analysis and prediction of the volume of sales of news, estimation of marketing income. Determining price elasticity with respect to income. Studying the price policy of competitors. Development of innovation pricing policy. Analysis of marketing costs. Forming the costs of moving the innovation to the market.

Table 1.2 shows that the importance of different concepts and approaches to innovation management is not equal. Systematic, marketing, life-cycle and project approaches occupy the greatest place in both strategic and operational innovation management. They form a special type of innovative management. Socio-psychological and quantitative econometric methods are used in the analysis, forecasting and development of management decisions.

The information presented in the table makes it possible to distinguish the following most characteristic symptoms of innovative management:

• complex hierarchical mixed scientific-technical and socio-economic systems will be the object of innovative management;

• consists of different district innovation systems with different visions of achieving the goal of innovative management;

• innovative processes have a probabilistic character and are weakly determined (based) by their essence;

• innovative processes have a creative nature;

• in innovation systems, the innovation field is the central subject of the employee-innovator;

• the identity of the innovator and the innovative manager as subjects of innovative activity should be considered as a complex social system that requires the use of the newest methods of influence;

• flexible, adaptive moral and personal approaches should be used to increase the effectiveness of innovative activities.

In innovation management, detailed analysis and improvement of management processes are more fully revealed in a systematic approach. The central concept of systematic analysis consists of a system, that is, a complex internal construction of components and elements that interact with each other and the environment, an object with a large number.

Understanding the organization as an open system is a key argument for innovative management. Being in close interaction with the external environment, it is exposed to a large number of influences, both direct and indirect, from the external environment. At the same time, the organization has an internal

microenvironment, the elements of which are interdependent with environmental factors.

The organization as a system consists of a complex ensemble of forces, interactions, interactions and interpenetrations of the system itself and the elements of its external and internal environment.

The external environment has a direct and indirect effect on the organization. State and legislative bodies, institutions, trade unions, scientific and innovative organizations, markets of production factors, investors, competitors, suppliers, consumers, professional intermediaries, etc. will be important elements of the direct impact environment.

Factors of the internal environment of the firm, for example, scientific and technical potential, morale, infrastructure, level of employee qualification, etc. enters.

The elements of the system are independent and qualitatively indivisible units. They describe interaction with each other and the environment as a material, energetic and informational environment. Spatial-temporal aggregates (summaries) of interacting elements with defined integrity and goal-orientation are divided into functional systems. Dividing the system into sub-systems allows us to reveal the hierarchy of the system and examine it at different levels of detail.

The complexity of the system is determined by the number of hierarchical levels, the volume of information circulating in the system, and the complexity of its structure, the number of elements and their connections. The sum of connections constitutes the structure of the system. Each system has an algorithm of operation aimed at achieving the set goal.

They form the system using a model that reflects the relationship between the system's input controllers, variables, variables, and output parameters. Large and complex systems consist of a collection of small systems and differ from them both quantitatively and qualitatively.

Large and complex hierarchical systems are characterized by:
• availability of common goals (identification);
• integrity and completeness;
• large amounts and large number of performed tasks;
• multifaceted and diverse tasks;
• the complexity of the behavior and the multifacetedness of the motivational reasons;
• existence of competitive, competing and omnidirectional tendencies.

A complex, large system consists of a set of systems and consists of multi-level, complex systems that provide, scientific, manage and control.Инновацияларни бошқаришда икки даража мавжуд:

1. The first level is represented by theories of social management of innovative systems and a system aimed at developing innovative development strategies, social and organizational changes, as well as other economic and socio-philosophical concepts that determine the functioning mechanism of the economic system.

2. The second level of innovation management is the practical theory of organization and management of innovative activities, due to which it acquires a functional and practical nature, and improves management, analyzes innovative activities, analyzes innovative activities, uses innovative technologies, employees, technical and provides a scientific and methodological basis for the development of practical solutions for the latest methods of influencing technological systems, products and financial flows.

The main stages of innovation management are presented in Figure 3 below. At each stage of the picture, the set tasks must be solved.

At the first stage (planning stage) - a strategy implementation plan is drawn up. In the second stage, conditions and tasks of organization are defined. This includes clarifying and defining resources for implementation in various departments of

the innovation period, assigning tasks to employees, and organizing work. In the third stage - the implementation stage, the development is carried out and the plan is implemented. The fourth stage, the leadership stage, involves monitoring, making corrections to actions, and gathering experience. Here, innovative projects, innovative management decisions, and the effectiveness of using innovations are evaluated.

According to economist A.M. Mukhamedyarov, the characteristics of the innovation process as a management object include three aspects:

1) disclosure of the content of the innovation cycle;

2) a clear idea of innovations in the content of the subject;

3) to determine the characteristics of innovative activities and scientific and technical developments aimed at creating innovations. any process can be managed only when the main directions of its development are known, when the features and laws of the object of management are known.

In conclusion, we can say that scientific development and innovation management are two important factors of science and technology development. Thanks to scientific development, many theories that form the basis of modern sciences have been created, and thanks to innovative management, organizations can create new products and technologies that improve people's lives and contribute to the development of the economy.

References

1. Yo'ldoshev, N.K. Menejment [Matn]: darslik / N.K. Yoldoshev, G.E. Zaxidov. - Toshkent: «O'zbekiston faylasuflari milliy jamiyati» nashriyoti, 2018. - 5 b.

2. https://studopedia.org/10-105706.html

3. Мухамедьяров А.М. "Инновационный менеджмент" учебное пособие – М.: Инфра – М, 2006. - 37 с.

4. Ўзбекистон Республикаси Президенти Ш.Мирзиёевнинг Олий Мажлисга мурожаатномаси. – Т.: Ўзбекистон, 22.12.2017 й.

5. Н.К.Йулдошев, У.Ш.Юсупов. Инновационный менеджмент и предпринимательство. (Учебник). –Т.: «Innovatsion rivojlanish nashriyot-matbaa uyi» 2022, 4 стр.

6. X.M.Abdusattorova. Innovatsiya strategiyasi. O'quv qo'llanma. T.: TDIU. 2011y. 14 b.

7. Ворабев В.П., Платонов В.В., Рогова Е.М., Тихомиров Н.Н. Инновационный менеджмент. Учебное пособие. 3 –е. издание. СПб. Издательство ГОУ ВПО «Санкт-Петербургский Государственный университет экономики и финансов», 2008 г. 7 стр.

8. В.Р. Веснин В38 Основы менеджмента. — М.: Институт международного права и экономики им. А.С. Грибоедова, 1999. — 9 с.

9. Инновационный менеджмент : электронный учебно-методический комплекс для специальности: 1-26 02 02-08 «Менеджмент (инновационный)». В 2 ч. Ч. 1. Основы инновационного менеджмента / БГУ, Экономический фак., Каф. инноватики и предпринимательской деятельности ; сост. О. Ю. Жуковская. – Минск : БГУ, 2022. – 105 с. : ил. – Библиогр.: с. 97–14.

10. Зинов В.Г. «Менеджмент инноваций: кадровое обеспечение» Учебник - М.: Дело 2005 – 96 с

11. Мухамедьяров А.М. Инновационный менеджмент: учеб.пособие. 2- е. изд. – М.: ИНФРА – М, 2008. – 10 с.

UDC 339.1

FOUNDATIONS OF NEUROMARKETING STRATEGY IN INDUSTRY

BOLTAEVA ZINORA

Senior teacher at Tashkent state university of economics

Abstract:

The purpose of the study examination for the theoretical foundations of such a relatively new branch of behavioral economics as neuromarketing. The paper discusses the main methods and tools of neuromarketing. In addition, the article provides a brief description of the possibilities of its application in modern realities.

The tasks of the research are research foundations of neuromarketing strategy in industry. As neuropsychology and cognitive sciences matured, a deeper understanding of higher brain functions emerged. The behavioral disciplines that emerged on the basis of neurophysiology and neuropsychology made it possible to analyze human reactions to advertising stimuli, determine the "correct" colors, track the effect on the subconscious of music and scents, analyze brain decision-making processes, determine benefits and risks. It is interesting to note that the name "neuroeconomics" has become a unifying name for the above-described areas of research.

The subject of the research is foundations of neuromarketing strategy in industry.

Research methods. Research using modern radiological techniques is actively developing today. Positron emission tomography (PET), single photon emission tomography (SPECT), functional nuclear magnetic resonance (fMRI), magnetoencephalography (MEG), transcranial magnetic stimulation (TMS), as non-invasive diagnostic methods, allow visualization of brain activity were used in the research paper.

The scientific novelty of the research is despite the controversy of scientists, many specialists began to increasingly turn their gaze towards neuromarketing. This is due to the fact that standard, well-studied and even reliable marketing approaches do not give the desired results in modern conditions.

Keywords: marketing, neuromarketing, neurolaboratory, neuromarketing methods, brain research, emotional involvement of the consumer, emotional stimulus.

Introduction. Neuromarketing is a set of activities that study the relationship of the human brain to marketing and advertising in particular. Research results make it possible to better predict the logic of the consumer, his reaction to stimuli by measuring processes in the brain.

The evolution of marketing concepts has almost always been influenced by psychological and neurophysiological thought. The beginning and middle of the twentieth century marked the beginning of the basic methods of neuroscience, the last ten years have been characterized by the active development of neuroimaging methods, which laid the foundations of neuromarketing tools.[5]

Literature review. The concept of neuromarketing, scientists believe, was developed by psychologists at Harvard University in the 1990s. However, the founders of this direction are traditionally considered the General Director of Retail branding A.G.Arndt Tryndl and the director of the store branding Retail branding Bart Oeyman.

The objective of this paper is to show the added value of using tools such as eyetracking, galvanic skin response, facial coding and others in the field of market research and user experience research. We will present 3 case studies in which these tools have been used successfully. We will give an overview of the background, the objectives, methods and results and how the neuro-tools provided additional insights into consumer behaviour, which would otherwise not have been possible. In this paper we will specifically show cases from packaging design, advertising research and user experience research thus only covering a small part of possible application areas.

A general neuromarketing technique was developed in the late 1990s by Harvard professor Jerry Zultman, who immediately patented it under the name ZMET (Zaltman Metaphor Elicitation Method). The essence of ZMET is to

recognize a person's subconsciousness using sets of specially selected pictures that cause a positive emotional response and activate hidden images-metaphors that stimulate a purchase. On the basis of the identified images, graphic collages are constructed, which are used as the basis for commercials. The data is then interpreted through interviews with a psychologist or by analyzing images of the brain. ZMET marketing technology quickly gained popularity among hundreds of large customer firms, among which Coca-Cola and Pepsi, Nestle, General Motors, Procter & Gamble, and others (more than two hundred large companies) can now be noted.[3]

Analysis and results. The scientific community has information about the direct use of magnetic resonance imaging equipment in neuromarketing research. He became a pioneer here at the turn of 2002 and 2003. an American scientific and commercial project called the Brighthouse Institute for the Science of Mind. The new MRI-based neuromarketing method he developed is similar to ZMET and also uses specially selected images. The only difference is that the reaction of the surveyed clients to the presented images is established not by the conversation of psychologists, but by direct scanning and analysis of the brain regions activated in this case. However, when studying the positive and negative reactions of the brain to certain images, neuromarketologists are absolutely not interested in the conscious reaction of a person. The reason for this is the stated goal of the study - to establish how effective advertising is in subconsciously stimulating the purchase of a particular product or in developing brand loyalty [2].
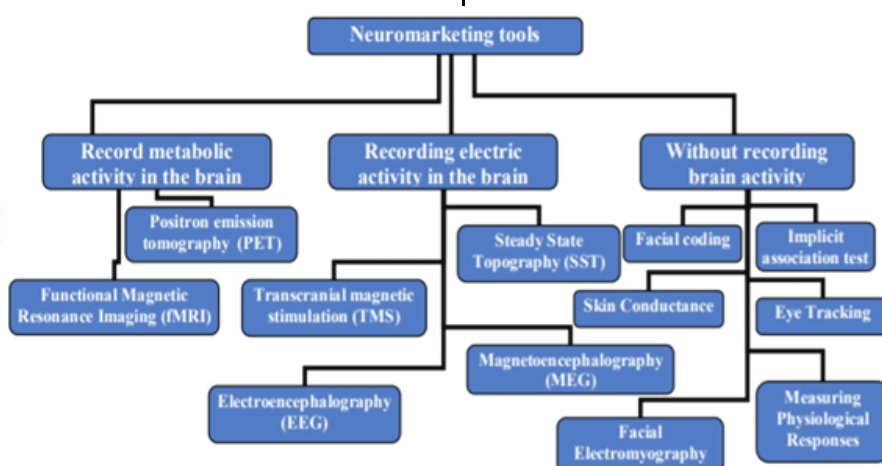
Fig.1. Classification of Neuromarketing Tools. Adapted from Bercea (2012).[6]

It should be noted that the most important advantage of neuromarketing over classic marketing is the ability to accurately identify which of the advertised products, brands or videos you just like, and which is really effective for making a decision. For example, in a neuromarketing study conducted by researchers in Australia, it was shown that a promotional video with rapidly changing episodes was not liked (as follows from subjective reports) of any of the participants in the experiment; moreover, the video was annoying. (Fig.1)

However, brain scans of the participants while watching advertising videos with different tempo of changing episodes revealed that it was the video with a fast pace that was remembered significantly better than static or low-dynamic videos. Subsequently, the product that was advertised in this "bad" video from the point of view of classic marketing was quickly recognized in the supermarket and bought more often.

As neuropsychology and cognitive sciences matured, a deeper understanding of higher brain functions emerged. The behavioral disciplines that emerged on the basis of neurophysiology and neuropsychology made it possible to analyze human reactions to advertising stimuli, determine the "correct" colors, track the effect on the subconscious of music and scents, analyze brain decision-making processes, determine benefits and risks. It is interesting to note that the name "neuroeconomics" has become a unifying name for the above-described areas of research.

Research using modern radiological techniques is actively developing today. Positron emission tomography (PET), single photon emission tomography (SPECT), functional nuclear magnetic resonance (fMRI), magnetoencephalography (MEG), transcranial magnetic stimulation (TMS), as non-invasive diagnostic methods, allow visualization of brain activity in real time. These techniques make it possible to objectively judge the brain activity associated with a person's response to a stimulus (for example, a commercial product). Neuroradiologists can now answer the questions about what emotions the buyer is experiencing, whether he made a positive decision to purchase, etc., quite objectively.[1]

To date, about a hundred results of full-fledged consumer behavior studies using neuroimaging methods have been published. Depending on the approach used, they can be conditionally divided into three groups:

1. Consideration of brands through the prism of consumer preferences. Creation of advertising and brand attributive architecture is especially effective in this direction. They include the following activities:

• research of consumer motivations;
• testing the concepts of advertising materials: as a complex of elements (illustration, slogan, main text, font, etc.), as a logical link, as a holistic image;
• peculiarities of perception of color aspects of advertising materials;
• identification of areas of consumer attention and areas of concentration of attention on objects of printed matter;
• creating or adjusting the brand image and studying the associations that consumers have with him and his personality - the distinctive features of the brand and more.

2. Representative assessment of possible alternatives of consumer preferences, through indicators of choice and making a purchase decision:

• determination of a set of properties of a product and its utility functions that affect consumer choice;
• identification of various indicators of the importance of product properties that are considered relevant to the consumer;
• establishing a set of beliefs (brand or product image) about the properties of the product and determining the degree of presence of each of them.

In the aspect of the above areas, one can cite a lot of research carried out by scientists at Stanford, Cambridge and other universities. Since microeconomic theory states that purchases are determined by a combination of consumer preference and price, these researchers investigated, using functional MRI, how consumers perceive the importance of these factors in purchasing decisions. It was proved that the choice associated with a conflict situation in the form of balancing between the desired object and its high price leads to the activation of the brain areas involved in the decision to purchase a product, and the corresponding conclusions were drawn.

3. Determination of the cognitive functions involved through attention and memorization of events in the process of consumption. As a rule, such studies are of a two-level nature:

• establishment of the consumer's "pyramid of values" (emotional, spiritual and cultural beliefs and values);

• testing the consumer's ability to retrieve previously offered product information.

Among many studies devoted to the third of the considered categories of neuromarketing research, M. Rothschild was one of the first to study how EEG activity will change in response to the visual presentation of advertising material. Analysis of EEG signals is no less a unique means of controlling higher-order neurocognitive processes than other, more expensive research methods.

The concept of neuromarketing boils down to the recognition of commercial applications, a better understanding of consumer behavior, the need to study consumer responses to marketing incentives using methods such as quantitative electroencephalography, functional magnetic resonance imaging, galvanic skin response, oculography, heart rate, respiration, body temperature measurements, and also studies of the reactions of the human brain to irritations of the human senses: sight, smell, hearing, touch and taste

A number of scientists distinguish three innovative concepts of modern marketing: neuromarketing, cognitive marketing, and sensory marketing.

However, most scientists believe that neuromarketing includes cognitive and sensory marketing. Some scientists consider neuromarketing to be nothing more than manipulation of customer behavior, and not at all a science.[4]

Despite the controversy of scientists, many specialists began to increasingly turn their gaze towards neuromarketing. This is due to the fact that standard, well-studied and even reliable marketing approaches do not give the desired results in modern conditions.

The point is that traditional marketing tools do not create the necessary, strong enough emotional irritants. Modern consumers have become more discerning, learned to adapt and more carefully select information coming from outside: from posters, banners, flyers, television and radio broadcasting.

Discussion of results. The ability of people to perceive stimuli from the environment, primarily at the level of neurophysiological signals, lies at the heart of the science of neuromarketing. On the basis of biophysical and biochemical processes, the human sense organs translate stimuli into the language of emotions at the subconscious level.

The main neuromarketing methods are:

Air tracking. The eye tracking method is used to observe the direction of a person's gaze, the size of his pupils, and the delay in gaze at a particular object. Based on this analysis, the color, font, and style of the brand are determined, product packaging is made, advertising materials are placed, videos, advertising posters and banners are shot.[9]

Study of heart rate, pulse and detection of increased sweating. To assess the emotional involvement and experiences of the client using a polygraph, a study of the heart rate, pulse is performed, and increased sweating is detected.[10]

Observing involuntary facial expressions. With the help of high-resolution video cameras, emotions and involuntary facial expressions of a person, including joy, surprise, irritation, interest, discontent, are recorded, which help analyze the respondent's reaction to video and contextual advertising and the design of a tourist product.[8]

Analysis of the brain reaction. Human brain scans are performed by two of the most advanced technologies: magnetic resonance imaging and a modern analog of the electroencephalogram, known as topographic mapping of the electrical activity of the brain. The analysis of the results obtained allows us to identify the most memorable types of tourist

advertising products. At the same time, one does not even need to ask what the subjects themselves remember.[7]

To date, based on neuromarketing research, the areas of the brain have been studied that are activated every time:

1) the person sees the products or brands that he prefers;

2) a situation of trust in the seller or the product arises;

3) you need to make a decision based on an assessment of the balance between the immediately received pleasure associated with the purchase of goods and at the same time received disappointment in connection with spending money;

4) pleasure or perception of beauty arises;

5) a person experiences altruistic feelings;

6) the negotiators' emotions prevail to the detriment of a cold mind, or, conversely, rational restraint remains, which suppresses emotions.

In summary, the main obstacle to the implementation of neuromarketing technologies in the development strategy of the organization is the need for significant financial investments.

Not every company can afford to purchase such expensive equipment, and especially to create its own laboratories.

But companies that do not have sufficient financial capacity for this kind of costs, ready to introduce innovative approaches to neuromarketing, may well use the services of research centers.

Conclusions. Neuromarketing is developing more actively abroad, and it is natural that large neurolabs are located in the countries of the West and Europe.

The experience of neuromarketing testing by the research center for Brand Management and Brand Technologies (RCB & B) is well known. He designed the style for the Fonty Fler flower chain, the BEC manufacturing and trading company and other trading companies. Nicholas Corot is Principal Curator of the RCB & B Research Center and Board Member of the Guild of Marketers.

Some global marketing experts believe that it is not necessary to conduct your own expensive neuromarketing research. In their opinion, it is enough to take advantage of foreign developments and ready-made results of neuromarketing research. This position fits well into the imitation strategy of diffusion of innovations.

References

1. Byrd K. Unconscious branding // Computerra. - 2006. - No. 46, p. 38-39.

2. Lindstrom M. Buyology: a fascinating journey into the brain of the modern consumer (translated from English. Falyuk E.). M .: Alpina Business Books, 2012 .-- 240 p.

3. Marketing: a large explanatory dictionary. - M .: Omega-L. Ed. A.P. Pankrukhina. 2010 .-- 256 p.

4. Lewis D. Neuromarketing in action. How to get into the brain of the buyer / per. from English: M .: Mann, Ivanov and Ferber, 2015 .-- 304 p.

5. https://link.springer.com/referenceworkentry/10.1007%2F978-94-007-6167-4_290-1

6. https://www.researchgate.net/figure/Classification-of-Neuromarketing-Tools-Adapted-from-Bercea-2012_fig1_335232446/

7. N. Lee et al. What is 'neuromarketing'? A discussion and agenda for future research International Journal of Psychophysiology (2007)

8. V. Sebastian. Neuromarketing and evaluation of cognitive and emotional responses of consumers to marketing stimuli. Procedia-Social and Behavioural Sciences (2014)

9. Murphy ER., Illes J., Reiner PB. Neuroethics of neuromarketing J Consumer Behaviour., 7 (2008), pp. 293-302

10. Reutskaja E., Nagel R., Camerer C.F., Rangel A. Search dynamics in consumer choice under time pressure: An eye-tracking study. American Economic Review, 101 (2) (2011), pp. 900-926.

ISSUES OF REGIONAL DEVELOPMENT OF SMALL BUSINESS

RASHIDOV RAHMATULLO

Head of Department, Namangan institute of engineering and technology
E-mail: r.rashidov84@mail.ru, phone.: (+99893) 498-96-84

Abstract:

Objective. Entrepreneurial activity is of particular importance for the development of the national economy. This article provides detailed information on the characteristics of entrepreneurial activity in the context of the transition to the innovative economy.

Methods. The research methods were statistical, comparative analysis, induction and deduction methods.

Results. The changes that have occurred in the economy in recent years require the development of a new, more complex stage of economic transformation, in which the center of gravity shifts to solving the problem caused by the technical-economic paradigm and systemic long-term changes. Term challenges that reflect global trends and domestic development barriers. In such conditions, small business plays an important role, which affects the socio-economic level of the country's economy in many ways. In the article, spatial mechanisms of small business development, factors, opinions of foreign scientists, existing problems are listed based on statistical analysis, and as effective solutions to these problems, recommendations on the development and implementation of issues of regional location of business entities are presented.

Conclusion. Boundary conditions for the successful operation of entrepreneurship in the innovative economy are revealed by taking into account the scale effect of firms of different sizes that arise as a result of profitability growth and operate as a systemic view. Qualitative and quantitative characteristics of a firm of a certain scale in the innovative economy act as self-developing value-economic, organizational-institutional and production-technological education.

Keywords: innovation, entrepreneurship, spatial development, spatial balance, evolutionary development.

Introduction. There is a need to develop a conceptual approach to form realistic ideas about the spatial development of small business, which allows for a satisfactory description of the production of knowledge, innovation and their reproduction within endogenous models. When micro-entities are directly aggregated into ideal market-type macrosystems, it allows to overcome the limitations of traditional analysis based on a simplified understanding of economic reality. The limitations of traditional analysis do not allow to properly take into account the spatial diversity of economic development, the specificity of interregional relations, as well as significant differences in socio-economic conditions for economic development. Taking into account the spatial dimension is of particular importance for our country due to the differences in the conditions for running a small business in the regions.

The study of the laws of evolution of the spatial mechanisms of small business development and the factors affecting them is important from the point of view of the development of economics. The increase in the density of filling the territories with farms and the involvement of new lands in the farm rotation led to an increase in the land deficit. This process is historical in nature, it was greatly accelerated due to the quadrupling of the world's population and the increase in the rate of economic development. The reduction of free spatial

resources and the expectation that this process will become more intense gives them special importance, leads to increased competition and puts the tasks of optimizing their use on the agenda.

The alternative concepts developed so far have certain advantages because they aim to identify the main patterns of spatial development and, accordingly, the relevant factors. However, they do not properly take into account all the diversity of the most important factors and relations, they do not allow to have a satisfactory picture of the economic activity and development patterns of small business. Today, a number of theoretical models based on many assumptions and simplifications are actively used. It should be noted that in the existing works [1] the set of spatial development factors is given quite widely, there are works on the assessment of the influence of individual factors on regional differences in the level and dynamics of development; on the other hand, there are no generally accepted ideas about which of these factors are primary and which are secondary, how much each of these factors should be taken into account in the implementation of regional policy, and without understanding the causes of problematic situations, developing adequate tools to support small businesses not possible.

Authors of econometric models try to take into account many factors when assessing their contribution to spatial development, but for many regions it remains difficult to explain a significant part of GNP growth; a holistic view of spatial development does not emerge because different sets of critical factors are often important for different regions. Currently, there is no coherent legal and conceptual framework for spatial development of small business. Society and government do not appreciate the negative consequences of the imbalance in small business development. At the same time, existing alternative theories describing spatial development processes based on center-periphery interdependence and cumulative growth complement each other to a certain extent and create a basis for a deeper study of these processes.

Analysis of literature on the topic. Currently, the laws of the processes of spatial development of economic activity are being clarified on the basis of various theories, each of which focuses on different aspects of these processes. The theoretical foundations of spatial development mechanisms were considered by A. Marshall [2], who introduced the concepts of "networked agglomerations" and "industrial districts". During the 20th century, studies in the field of regional development are becoming more and more popular, S. Cruz and A. Teixeira estimate that the share of publications on various aspects of regional agglomerations will exceed 5% in the 1980s[3].

In order to understand the processes of formation of regional models of innovative development of small business, the studies of modern changes in the organization of innovative processes are important. Thus, it was shown that they are characterized by the transition from the linear (industrial) model to the non-linear (neo-industrial) model proposed by K. Freeman [4], S. Klein and N. Rosenberg [5]. Lundwell and others focus on the formation of open innovation related to mass outsourcing and the creation of global value chains [6]. In modern conditions, the process of creating innovations is becoming more interactive, new sources of economic growth are emerging. The collective emergence of innovations and mutual benefits by the participants of cooperation are facilitated by the wide distribution of network structures and clusters that form a certain ecosystem. The change and new functions of universities, small businesses and the state, as well as the changing nature of their interaction in the formation of innovative activity in a certain area, are described by the three-helix model [7].

Currently, a new wave of "unbalanced development theory" is forming. The main objects of analysis are "local economic interconnections", the most popular of which are complexities, networks and clusters [8].

Research methodology. The author's approaches are presented based on the study of scientific literature and articles of foreign scientists on the subject and the analysis of the experiences of foreign companies in this regard. Also, in order to increase the scientific and practical value of the article, statistical analysis methods (dynamic and comparative analysis methods) of the data of the State Statistics Committee of the Republic of Uzbekistan were used.

A methodical approach based on an improved research paradigm is proposed in accordance with the subjective nature of economic reality for the appropriate description of the processes that determine the characteristics of the formation of various territorial models of the innovative development of small business.

Analysis and results. Considering the processes of spatial development of the national economy and small business from the perspective of the concept of dynamic capabilities and taking into account the rules of systematic analysis, the theory of complexity and evolution allows us to identify the following features and regularities, these processes:

- a systematic connection of territorial objects with different change capabilities in the course of constant interactions occurring in the internal and external environment, they are not completely autonomous from each other, but interdependent;

- accumulation of changes and acquisition of new characteristics of territorial subjects and national economy occurs on the basis of development and implementation of their dynamic abilities, their formation depends on the activity of entrepreneurial structures and the role of small business;

- common corridor of spatial development of entrepreneurial structures and small business defines knowledge base and basic technologies, cultural and value directions and institutions.

Changes in the conditions for small businesses associated with the transition to innovative competition impose new requirements on the formulation of innovation policy, the selection of priorities, models and tools for its implementation. According to the data of the State Statistics Committee, the analysis of the distribution of small enterprises by regions of Uzbekistan allows us to conclude that the main part of small enterprises is concentrated in the city of Tashkent, and this trend continues. (Table 1).

Table 1.

Distribution of small businesses and micro-enterprises by regions of the Republic of Uzbekistan in 2018-2021 (according to those registered) [10]

No	Indicators	2018 year		2019 year		2020 year		2021 year	
		Quantity, unit	%	Quantity, unit	%	Quantity, unit	%	Quantity, unit	%
1	**According to the Republic of Uzbekistan**	**242379**	**100**	**276237**	**100**	**353921**	**100**	**436981**	**100**
2	Republic of Karakalpakstan	11076	4.6	12364	4.5	15050	4.3	18923	4.3
3	Andijan region	21631	8.9	23978	8.7	28880	8.2	35795	8.2
4	Bukhara region	13495	5.6	15700	5.7	20982	5.9	26097	6.0
5	Jizzakh region	10069	4.1	11845	4.3	14769	4.2	18661	4.3
6	Kashkadarya region	14969	6.2	16752	6.1	20921	5.9	26088	6.0
7	Navoi region	7788	3.2	9143	3.3	15511	4.4	19058	4.4
8	Namangan region	16928	7.0	17944	6.5	22034	6.2	27314	6.3

313

9	Samarkand region	17261	7.1	20669	7.5	27322	7.7	35022	8.0
10	Surkhandarya region	10897	4.5	11670	4.2	15783	4.5	22670	5.2
11	Syrdarya region	8064	3.3	8947	3.2	11697	3.3	14256	3.3
12	Tashkent region	25128	10.4	29390	10.6	38006	10.7	45935	10.5
13	Fergana region	20502	8.4	23542	8.5	29599	8.4	37199	8.5
14	Khorezm region	11345	4.7	12576	4.6	16282	4.6	20177	4.6
15	Tashkent city	53226	22.0	61717	22.3	77085	21.8	89786	20.5

As can be seen from the table, if in 2020, 21.8% of small enterprises and micro-firms are located in this area, then in 2021, 20.5 percent of the total number of small enterprises and micro-firms of our country, or 89,786, are operating in the territory of Tashkent city. The next place is Tashkent region. In 2018, 25,128 small enterprises and micro-firms were registered in this region, and by 2021 there will be 45,935. Their share in the total was 10.4 and 10.5 percent, respectively.

The position of small enterprises and micro-firms according to the share of the total by regions is presented in the following figure (Figure 1).

Spatial regularities of economic activity and small business development processes reflect the complexity, multifacetedness, interdependence and unevenness of its change, under the influence of territorial self-reinforcing and cumulative processes, based on the specific characteristics of the influence of endogenous factors. These spatial patterns of economic activity and small business development are reflected in the following.

1. The interaction of heterogeneous regional entities with different resources, powers and abilities in a single economic-temporal space under the influence of endogenous factors leads to the formation of central-periphery direct and feedback links, in which regional self-reinforcing mechanisms are accumulated in a linear causal relationship. innovative development is manifested due to the creation of non-existent processes and synergistic effects. The center-periphery structure is the main and final principle of the construction of the geographical space, which gives rise to the center-periphery way of development of the economy and its regions , in which the centers of different levels always attract resources from their edges.

In this regard, a hierarchy of spatial systems of business activity is created. This involves considering the evolution of small business in light of the impact of power relations of a different nature, as groups of entities interact in organizational fields with different economic and cultural values, power resources, and powers. With this approach, the development of the national economy implies the emergence of spatial characteristics of the value-institutional system change.

2. Spatial laws describe the evolution of the center-periphery mechanisms of innovative development of the regional economy, their characteristics are largely determined by the scale and activity of small businesses. They represent that large cities act as growth points or development poles due to the positive effects of the scale and structure of agglomerations. At the same time, production industries with a high potential for innovative development become centers of "concentration" of other industries that are suppliers of resources or consumers of their products and services in their sphere of economic influence; technological, infrastructural, financial, scientific, educational and social-cultural polarization processes are developing in the future. Decentralized areas are changing due to the spread of impulses for innovative development and the formation of direct and feedback links mainly due to the spread of innovations, which depends on the characteristics of the process of interaction of formal and hidden knowledge.

314

3. Territorial evolution of business structures, regional evolution of economic activity, as a result of the complex interaction of centrifugal forces in the territorial space, various resources and dynamic capabilities are formed in connection with the movement of not only goods, but also labor, capital and economic structures. At the same time, small business has a significant impact on the nature, dynamics and direction of the processes of spatial changes, on the formation of knowledge formation and transfer mechanisms, and on the adaptation of regional entities to the changing business environment.

Territorial distribution of business activity and polarization of the territorial structure of the economy is determined by the ratio of benefits and costs that arise when its subjects are located in a certain area and reflects the relationship of positive and negative effects. This is due to various combinations of factors such as interaction costs between business structures (transportation and trade costs), increasing returns to scale, market size and variety of manufactured products. The trend of spatial concentration of business activity is typical for manufacturing agglomerations, which are sensitive to the impact of increasing income in terms of scale and network structure.

4. Formation of competitive advantages of regions occurs under the influence of a set of interconnected factors. As stated by P. Krugman, they can be divided into two groups; first, the availability and geographic location of natural resources demanded by the market, including the border of world trade routes, which reduces transportation costs; secondly, advantages created by economic activity (agglomeration effects, human capital, institutions supporting entrepreneurship, mobility of labor and financial resources, innovation, etc.).

5. World experience shows that in the course of the evolution of the industrial economy, the role of the first-order factors in the formation of the competitive advantages of regions - the supply of resources and geographical location factors - decreases, but the importance of the second-order factors, factors related to urbanization, agglomeration, and the strengthening of the highway, increases. In the future, the role of third-level factors - regional factors of innovative development - which fundamentally change the nature and mechanisms of increasing the competitiveness of regions is increasing. At the same time, the scale influence of large enterprises loses its previous importance, and the active participation of small business entities in the development of the region becomes important.

6. Complex processes of spatial development are accompanied by various types of "market failures" that cause insufficiency of self-development mechanisms of the market. In this regard, there is a need to apply various horizontal and vertical connections, cooperative and market mechanisms, and scientific and technical processes within the framework of the common territorial space to regulate the formation of resources and capabilities of the regions, the formation of knowledge and the transfer of knowledge, which ensure the proportional and uneven development of dynamic abilities. They allow to obtain the best cumulative-synergistic macro effect in a strategic perspective based on market opportunities and risks.

Based on these laws, we can see the distribution of small businesses and micro-firms in our country by types of economic activity from the following table (Table 2).

Table 2.

Analysis of distribution of small businesses and micro-firms by types of economic activity [10]

No	Indicators	2018 year		2019 year		2020 year		2021 year	
		Quantity , unit	%	Quantity , unit	%	Quantity , unit	%	Quantity , unit	%
1	**Total**	**229666**	**100**	**262930**	**100**	**334767**	**100**	**411203**	**100**
2	Agriculture, forestry and fisheries	20530	8,9 _	23975	9.1	28847	8.6	40719	9.9
3	Industry	48566	21.2	56233	21.4	69970	20.9	82746	20.1
4	Construction	23807	10.4	28955	11.0	36021	10.8	40695	9.9
5	Trade	62714	27.3	70457	26.8	100573	30.0	131597	32.0
6	Transport and storage	11779	5.1	13121	5.0	15157	4.5	17056	4.2
7	Accommodation and dining services	16964	7.4	19565	7.5	25461	7.6	29947	7.3
8	Information and communication	6167	2.7	6738	2.6	7621	2.3	9221	2.2
9	Provision of health care and social services	4417	1.9	5364	2.0	6370	1.9	7588	1.9
10	Other types	34722	15.1	38431	14.6	44747	13.4	51634	12.5

As can be seen from the data of this table, the highest share in the distribution of small enterprises and micro-firms in our country by types of economic activity belongs to trade. In 2018, 62,714 small enterprises and micro-firms were active in this field , and in 2021, there were 131,597. Its share in the total was 27.3 and 32.0 percent, respectively.

Small businesses and micro-firms have achieved high growth in trade and industrial types of economic activity.

The phenomenon of industrial agglomeration or regional concentration is often explained using neoclassical equilibrium models that take into account returns to scale. According to this approach, in accordance with J. Williamson's theory of territorial disparity and A. Fisher's and E. Hoover's theory of territorial development stages, a gap in spatial levels appears in the initial stages, development first increases, and then territorial disparities decrease. The trajectory of regional differentiation takes the shape of an inverted U, the so-called Williamson curve. According to the theory of J. Williamson, economic growth in the initial stages is concentrated in the central regions (core) of the country, and then spreads to the peripheral regions.

Therefore, with the growth of national wealth, the high degree of regional polarization is replaced by the leveling of regional differences. Regional policy should not limit the movement of market forces of agglomeration, which initially have a positive effect, and then, as a result of the accumulation of negative effects, the flow of capital and labor is directed to poor regions [11].

However, this theory does not take into account the influence of all contextual and institutional factors of the market. First, the continuous production of innovations in the center leads to the dependence of the growth of the backward regions on the transfer of new technologies. Secondly, border regions have more opportunities to attract public investment in social and logistics infrastructure. Therefore, with the growth of national wealth, regional inequality increases under the influence of market forces of agglomeration.

World experience shows that at the end of the 20th century, economic inequality significantly increased in catching up with countries, which ensured the rapid development of regions with clear competitive advantages, as a result of which the economies of these countries also developed more successfully.

Gradually, attention is being paid to the development of other regions, but at the same time, the policy of encouraging the development of local regions with a competitive advantage, increasing agglomeration and innovation effects, is being continued.

Today, the differences in approaches to the formation of regional models of innovative development of small businesses are mainly determined by the fact that these models have different structural and dynamic characteristics due to the diversity of the business environment, and are divided into different ranked groups depending on the selected classification criteria. Studying the characteristics of regional innovation processes in the development of small business allows to classify them, it helps to understand the systematization of knowledge and the mechanism of creation of innovations and their use, makes it possible to compare the possibilities of creating competitive advantages, evaluates alternative approaches and ways of further development of business entities.

Conclusions and suggestions. When analyzing the processes of formation of territorial models of innovative development of small business, it is reasonable to conclude that their most important parameters form a multi-level system, are complexly interrelated and subordinate to each other. It is of particular importance to develop an approach that allows for a systematic interpretation of the processes of formation of unique regional trajectories of innovative development of business entities that ensure the

successful creation and implementation of competitive advantages, and the use of typology as its basis. Based on the specific characteristics of the interaction between production-technological, cultural-value, organizational-institutional and cycle-time factors, the nature of participation in the processes of creation, transmission and repetition of innovations is important.

Within the framework of the considered approach, it is important to distinguish four types of regional models of innovative development of small business, which play a key role in understanding the laws of the formation of the innovative profile of small business development - national, national-territorial, regional and less developed peripheral, they can have different levels of development (low, medium, high).

The first type of model - the nationally oriented model of innovative development of small business - ensures the satisfaction of national needs and the needs of international markets for innovation. In this model, fundamental research is particularly important in universities and small businesses that actively collaborate with knowledge producers and innovation firms in other regions. An example of this type of model is the technopolis established in countries such as France, Japan, and Taiwan, which is characterized by a limited degree of interaction between innovative small firms within the policy framework, as well as developed vertical ties with them. Large firms in these areas are generally regarded as anchors of technopolises. The research functions of universities and corporations are mainly focused on creating radical innovations.

References

1. Ivanter, V., Uzyakov, M. Innovative variant development: long-term forecast / V. Ivanter, M. Uzyakov // Economist. 2007. No. 11. S. 13–27

2. Marshall, A. Principy ekonomicheskoy nauki: v 2 t.; per. English M.: Progress, 1993. T. 1. 415 p.

3. Cruz, S., Teixeira, A. The Evolution of this. Cluster Literature: Shedding Light on the Regional Studies V Regional Science Debate. Regional Studies. 2011. V. 44. 9.

4. Freeman, C. Technology Policy and Economic Performance / C. Freeman. London: Printer Publishers, 1987. 284 p

5. Klamer, AA Pragmatic View on values in Economics // Journal of Economic Methodology. 2003. June. V. 10. 2. pp. 192–21

6. Chesbrought, HW The Era of open Innovation MIT Sloan Management Review. 2003. V. 44. 3.

7. Etzkowitz, H., Leydesdorff, L. The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations Research Policy. 2000. V. 29.

8. Markov, S. Franchising: reshenie problem razvitiya biznesa / S. Markov // Problem theory and practical management. 2006. No. 3. S. 104–107.

9. Crevoisier, O. Beyond/Territorial Innovation Models: The Pertinence of the Territorial Approach. Regional Studies. 2014. V. 48. 3.

10. The State Statistics Committee of the Republic of Uzbekistan "Small entrepreneurship in Uzbekistan 2017-2020" collection. Tashkent-2021. pp. 54-55

11. Williamson, JG Regional Inequality and the Process of National Development: a Description of the Patterns. Economic and Cultural Change. 1965. 13. pp. 1–84.

12. Romanenko Elena Vasilievna "Razvitie malogo predprinimatelstva v usloviyakh innovatsionnoy ekonomiki". Saint Petersburg – 2018

13. Alojonovich R.R Resource-saving technologies in cotton-growing economic efficiency indicator systems. Plant Cell Biotechnology and Molecular Biology. 19 February 2021

14. Rashidov R.A. Economic efficiency of resource-saving technologies in the cotton industry system of indicators. International Journal of Scientific and Technology Research. November 2019

ISSUES FOR ENSURING ECONOMIC STABILITY OF CHEMICAL INDUSTRY ENTERPRISES USING FOREIGN EXPERIENCE

KADIROV ABDUMALIK
Researcher of Tashkent State University of Economics
E-mail: abdumalik.kadirov@list.ru

Abstract:

The purpose of the study is ensure the economic stability of chemical industrial enterprises, the article covers the experience of companies of foreign countries and highlights the aspects of use in local chemical industrial enterprises..

The tasks of the research are research for theoretical and practical aspects for ensuring economic stability of chemical industry enterprises using foreign experience.

The subject of the research is issues for ensuring economic stability of chemical industry enterprises using foreign experience.

Research methods. Analysis and synthesis, induction and deduction, systematic approach, systematic analysis, abstract-logical thinking, monographic observation, comparison, statistics, economic analysis and economic-mathematical methods were used in the research paper.

The scientific novelty. It is an accepted trend to study the experience of companies of advanced foreign countries in the matter of ensuring the economic stability of chemical industry enterprises. Including, revealing the specific features of the introduction of a modern controlling system, and scientifically proving the effectiveness of its application to the activity of chemical industrial enterprises operating in our country is the main essence of the research.

Keywords: industry, economic stability, US, European experience, management, control.

Introduction. It is known that by the end of the 21st century, different approaches aimed at the strategic management of business entities were formed, and they began to surpass the concept of accounting. In particular, in the scientific economic literature, almost no attention is paid to the quantitative evaluation of the impact of the introduction of the controlling system on the indicators of the enterprise's production-economic, financial-economic and organizational-management activities.

In particular, despite the fact that some researchers have reflected in their scientific works on the positive aspects of the introduction of control, no quantitative assessment of the impact of the introduction of the control system on the indicators of economic stability of the enterprise has been carried out. [3]

In particular, Uzbek economist Nurimbetov R.I. and Akhmedov S.I. in their research [1] studied that the introduction of product quality management in the United States began to develop rapidly with the production of a wide range of consumer goods. But they found out that the quality of the goods is very low.

According to American experts, 25-30% of the current costs of enterprises were spent on identifying and finding product defects. The cost of replacing defective products would exceed 30% of the total cost. Many US experts believed that low quality was the main obstacle to increasing labor productivity and competitiveness. Japan's experience has shown that improving quality is a never-ending task. He pointed out that the main concept of the "Japanese miracle" is perfect technology, whether it is production, management or service.

From this point of view, based on the analysis of foreign experience in the implementation of the controlling system to ensure the economic stability of industrial enterprises and the results obtained based on the use of the developed methodological approaches, it is possible to draw general conclusions regarding the impact of the introduction of the controlling system on the effectiveness of certain areas of business entities and the entire enterprise. It is appropriate to develop the indicators.

It is an accepted trend to study the experience of companies of advanced foreign countries in the issue of ensuring the economic stability of industrial enterprises. Including, to reveal the specific features of the introduction of the modern controlling system, and to scientifically prove the effectiveness of its application to the activities of the industrial enterprises operating in our country is the main essence of the research.

Methodology. It is possible to reflect the activity of any enterprise with the dynamics of certain economic indicators, in which mutual harmony and dependence can change as the enterprise moves from one state to another. The interdependence of all indicators is described by the concept of "work order". Each work order of the enterprise interprets the system of established indicators, if they are classified according to the growth rate, the standard work order of the enterprise, in other words, a normative system of indicators, is created. Studying the activity of an industrial enterprise is carried out on the basis of comparison of the actual dynamic range of the enterprise with the standard range. In this article, the problems of ensuring the economic stability of canoe enterprises were studied through scientific abstract-logical thinking and comparative analysis. In addition, the methods of induction and deduction were widely used to assess the possibility of ensuring the economic security of the enterprise only if all participants of the processes of ensuring the economic stability of industrial enterprises work together. Also, methods of scientific observation were used in the development of ways to ensure economic stability of the enterprise.

Analysis and results. The results of testing the selections for the correctness of

319

the law of probability distribution allow us to conclude that the rates of growth of management efficiency and the rates of growth of production process efficiency obey the correct distribution law. The range of change of control system effectiveness indicators, including the growth rate of management efficiency was 7.2% - 25.0% and the growth rate of production process efficiency was 8.4% - 25.9%.

Table 1

Changes in some economic indicators of industrial companies of foreign countries as a result of the introduction of the control system [9]

Company	Growth rate of investment attractiveness, %	Growth rate of document circulation efficiency, %	Financial and economic stability growth rate, %
British Petroleum	+11,4	+5,2	+6,3
Tesco	+9,3	+11,6	+8,9
METRO GROUP	+7,2	+15,3	+22,1
Cristall Gross	+6,5	+11,3	+22,5
Ford	+1,2	+14,8	+6,3
Mazda	+16,8	+27,6	+9,9
Bayer AG	+3,5	+5,2	+2,2
Schwarzkopf	+6,3	+8,9	+9,3
Oriflame	+3,3	+9,3	+5,7
Motorola	+6,8	+9,3	+11,0
Chivas	+3,9	+1,6	+5,2
Huawei	+16,5	+11,9	+3,5
Ziegler	+0,2	+0,96	+0,45
Singer Corporation	+1,6	+2,9	+3,6
Renault	+13,3	+6,9	+9,2
IBM	+33,9	+11,8	+6,9

In particular, mathematical estimates for the growth of management efficiency in foreign industrial enterprises are 13.25%, and the rate of growth of production process efficiency is 20.53%. At the same time, the integral indicator calculated on the effectiveness of the introduction of the controlling system in the enterprise is 16.49% [2].

As a result of the introduction of the controlling system, the results of the analysis of the change in the performance indicators of foreign industrial enterprises made it possible to identify the following positive trends in the development of these economic entities (Table 1).

Firstly, as a result of the introduction of one or another type of controlling system in the enterprise, it allowed to increase the level of investment attractiveness up to 90% on average (IBM showed the maximum increase - 33.9%).

Secondly, the documents made it possible to increase the cycle efficiency by an average of 10% (Mazda showed the maximum increase - 27.6%).

Thirdly, it made it possible to increase financial stability by an average of 8% (the Crystal Gross company showed the maximum increase – 22.5%) [5].

Including, as a result of the introduction of the controlling system in enterprises, the level of investment attractiveness increased by 8.9%, the efficiency of document circulation - by 9.7%, and financial stability - by 8.3%.

The financial stability of the enterprise is determined on the basis of the alternative coefficient, calculated by the ratio of the company's own funds and accounting

balance to the total value of assets and liabilities.

Thus, from the analysis of the growth rate of investment attractiveness, efficiency of document circulation, and financial stability of the industrial enterprises of foreign countries mentioned above, it can be concluded that the introduction of this or that controlling system is an encouragement to ensure the economic stability of the enterprise and increase the efficiency of its activity.

In particular, despite the fact that the growth rates of these indicators in various enterprises have an unstable fluctuation trend, the dynamics of change in all analyzed companies is positive.

Therefore, the introduction of a controlling system in industrial enterprises makes it possible to increase the level of economic stability of economic entities, and this is especially relevant during the crisis in the economy.

E.A. Borghardt and V.M. Nosova OJSC "KamAZ" in its works dedicated to the introduction of the controlling system in the enterprise noted that the following results can be obtained from the introduction of this system: "the labor productivity of management personnel increases by 9.6%, the effectiveness of the decisions made increases by 11%, based on the control measures the effect of making long-term financial decisions is about 20%" [6].

One example is AT&T Canada, the largest mobile operator in Canada, which has achieved success as a result of the implementation of the controlling system. This company introduced a system of measured indicators (Balanced Scorecard (BSC). As a result of the implementation, the following economic efficiency was observed: the profit from sales increased by 15%, the production volume per worker increased by 11%, and the market value of the enterprise increased by 4 times [7] .

The introduction of the controlling system at the Airbus Group company had a positive effect on turnover profitability, and this indicator increased by approximately 10% by 2015 [8].

In this regard, it can be concluded that there was an increase in efficiency in one or another field of activity in the analyzed companies of foreign countries.

Conclusions and suggestions. In this study, the indicators for evaluating the impact of the controlling system on the performance of some foreign companies are presented. Based on the indicators presented in this table, it can be concluded as follows.

Firstly, despite the fact that in most cases, controlling is considered only in the form of control and accounting, or in a shortened version of its tasks, all researchers admit that the introduction of the controlling system has a positive effect on the financial and economic indicators of economic entities.

Secondly, the results of the analysis show that the range of efficiency of management decision-making on the introduction of the controlling system in enterprises was from 8.7% to 16.2%.

Thirdly, as a result of the introduction of the controlling system in enterprises, the increase in labor productivity of management personnel is observed from 9.6% to 17.2%, that is, an average increase of 13.4%.

Fourthly, the introduction of a controlling system in enterprises has a positive effect on the overall management efficiency. The growth rate of this indicator is from 7.2% to 36.9%.

Fifth, the introduction of the controlling system affects the quality of the decisions made. Only one of the analyzed enterprises has this indicator, and its average growth rate was 41.0%.

Sixth, the introduction of a controlling system in industrial enterprises leads to an increase in the growth rate of the production process efficiency by 8.4-31.9%, that is, by an average of 20.5%.

Based on the above analysis, it was possible to draw a clear conclusion on the

effectiveness of the introduction of the controlling system.

In particular, the introduction of the controlling system is of urgent importance in the context of the globalization and integration of the world economy and unstable economic fluctuations in the world market; efficiency reserves determined during the implementation of the controlling system can be a certain tool to reduce the negative impact of external environmental factors on the economic stability of the enterprise.

In addition, in our opinion, the integrated approach to the controlling system, which should be introduced, both financially and economically, not only the control, accounting and budgeting tasks, but also, first of all, the tightening of the integration processes, the instability of the market situation and the environment of uncertainty of the enterprise the application of expanded tasks, which include the possibilities of effective management of activities, will ensure the economic stability of industrial enterprises and expand the conditions for reducing external negative consequences by the economic system of the enterprise.

References:

1.Nurimbetov R.I., Ahmedov S.I. Ishlab chiqarish menejmenti. O'quv qo'llanma. – T.: Talqin, 2008. – 112 bet.

2. Khudyakova, T.A. Implementation of controlling technologies as a way to improve the efficiency of the enterprise / T.A. Khudyakova // Bulletin of SUSU. Series: Economics and Management. - 2016. - T. 10. - No. 4. - P. 30–36.

3. Khudyakova, T.A. Principles for determining the effectiveness of costs for the implementation of the controlling system at an industrial enterprise / T.A. Khudyakova // Bulletin of SUSU. Series: Economics and Management. - 2014. - No. 4 (8). – P. 135–138.

4. Khudyakova, T.A. Principles for assessing the level of financial and economic sustainability of an enterprise based on the use of probabilistic and statistical models / T.A. Khudyakova // Bulletin of SUSU. Series "Economics and Management". - 2015. - T. 9. - No. 3. - P. 41–43.

5. Yusupova, S. Ya. Theory and practice of implementing a controlling system in the information society: author. dis. … doc. economy Sciences: 08.00.05 / Yusupova SavdaYaragievna. - M., 2008. - 37 p.

6. Kozin M.N. Dynamic model for assessing the production and economic sustainability of a defense enterprise / M.N. Kozin // Audit and financial analysis. - Moscow, 2007. - No. 4. - with. 24-31.

7.Sakhovskaya, K.A. Strategic controlling as a tool for effective enterprise management / K.A. Sakhovskaya, N.A. Tsaplina // Modern trends in economics and management. - 2014. - No. 24. - P. 54–58.

8. Hubert, T. Financial controlling in the European aerospace and defense concern Airbus Group S.A.S. / T. Hubert, S.G. Falko // Controlling. - 2015. - No. 55. - P. 3–9.

INVESTMENT PROCESS IN THE REPUBLIC OF UZBEKISTAN

NARZULLAEV KOMILJON

Namangan engineering-construction institute
E-mail: narzullaev.komiljon@rambler.ru, phone.: (+99894) 508-31-02

Abstract:

Objective. This article is devoted to the state program «Strategy of actions in five priority areas of development of the Republic of Uzbekistan in 2017-2021» and «The New Uzbekistan's Development Strategy» developed and implemented at the initiative of the President of the Republic of Uzbekistan Sh.Mirziyoyev. That these state programs are aimed at the timely and effective solution of pressing issues, as well as its impact on the growth rate of the country's economy, including the issues of attracting foreign investment in the economy of the republic.

Methods. For a comprehensive consideration and obtaining objective results, this article uses the methods of system analysis, complex analysis, comparison, decomposition of problems and goals.

Results. Based on a systematic analysis of the data, it was revealed that bureaucratic barriers and obstacles in working with investors, especially in the field, consisting in the lack of proper support from khokimiyats of all levels of investor initiatives, clear coordination of the work of ministries and departments in this direction, hinders the strengthening of confidence in the consistency of state policies to create a favorable investment climate. In this regard, the creation in the country of the most favorable investment climate for foreign investors should be guaranteed by legal measures. Along with this, the article indicates the main directions for attracting foreign capital at the present stage of the country's economic development.

Conclusion. A systemic relationship is shown - an effective investment policy developed on the basis of the specifics of the country and the problems that hinder foreign investment. The main tasks are given, the implementation of which will create not only jobs, but also relieve economic tension and, of course, save significant financial and material resources. Attention is focused on the issues of the state economic program - «Strategy of action in five priority areas of development of the Republic of Uzbekistan in 2017 - 2021» and the logical continuation of this program «The New Uzbekistan's Development Strategy».

Keywords: sustainable development, crisis, modern state policy, action strategy, priority areas, foreign capital, foreign investment, investment climate, investment project.

Introduction. The solution of socio-economic, political issues, ensuring the sustainable development of the state, including its regions, is possible if the country's economic growth is at least 5% per year.

In a crisis for developing countries, the successful functioning of the national economy can be achieved with the necessary organization of state regulation and the creation of an optimal market infrastructure, i.e. development of modern state policy.

«State economic policy is a set of measures carried out by state bodies aimed at streamlining, adjusting and maintaining the socio-economic processes of the development of society, which provide economic growth and the necessary level of welfare of the country» [1].

In the Republic of Uzbekistan, in order to ensure the sustainable development of the country, the President of the Republic of Uzbekistan Sh. Mirziyoyev proposed and successfully implemented the state program «Strategy of action in five priority areas of development of the Republic of Uzbekistan in 2017 - 2021» [2]. The action strategy included:

➢ improvement of state and public construction;

➢ ensuring the rule of law and further reforming the judicial and legal system;

➢ development and liberalization of the economy aimed at further strengthening macroeconomic stability and maintaining high economic growth rates;

➢ development of the social sphere, aimed at a consistent increase in employment and real incomes of the population;

323

➢ ensuring security, interethnic harmony and religious tolerance, implementing a balanced, mutually beneficial and constructive foreign policy aimed at strengthening the independence and sovereignty of the state, creating a belt of security, stability and good neighborliness around Uzbekistan, strengthening the international image of the country.

At the present stage of development of the Republic of Uzbekistan, it is also necessary to present a picture of reforms based on the development strategy of New Uzbekistan for 2022-2026, which consists of seven priority areas developed according to the principle «From Action Strategy to «The New Uzbekistan's Development Strategy»», which has become an actual program. In accordance with this, a person, his rights and happiness should be the most important goal of state policy and the activities of all state structures. It was emphasized that the construction of society and state policy should be based on this idea and should be organized on the basis of the principle of «State for the people» [3].

Methods. For a comprehensive consideration and obtaining objective results, this article uses the methods of system analysis, complex analysis, comparison, decomposition of problems and goals [4]. In particular, foreign investment is vital for achieving such goals as getting out of the crisis, the initial recovery of the country's economy. In the document noted above, the third point is «development and liberalization of the economy» and «...active attraction of foreign investment in the sectors of the economy and regions of the country by improving the investment climate».

However, local interests do not always coincide with the interests of foreign investors.

Investors, regardless of the nature and form of investments, set the key goal of investing to return their own investments, both in kind and in value terms. The natural form in this case refers to the return on investment as the real volume of the product. The value expression represents various forms of monetary forms and relations [5].

Therefore, it is necessary to take into account their interests. The owners of financial resources were confident in the success of their investments. At the same time, it is necessary to direct their actions towards solving the economic problems for which they were involved.

Currently, in the Republic of Uzbekistan, the main and most important thing for foreign investors is the stability in the country, the open and transparent policy of the head of state Sh. Mirziyoyev.

The President of the country is the guarantor of protecting the interests of both domestic and foreign capital investors. It guarantees foreign investors protection from political and economic risks [6].

Results. In the «Decree of the President of the Republic of Uzbekistan» Sh. Mirziyoyev «On measures to radically improve the investment climate in the Republic of Uzbekistan» dated August 1, 2018, it is noted that «there are bureaucratic barriers and obstacles in working with investors, especially in the field, consisting in the absence due support from khokimiyats of all levels of investor initiatives, clear coordination of the work of ministries and departments in this direction, which hinders the strengthening of confidence in the consistency of state policy to create a favorable investment climate» [7].

In order to create the most favorable investment climate in the country for foreign investors, the following legal measures have been taken:

➢ the investor is compensated for property damage incurred due to trust in the legal force of an administrative act of a state body adopted in relation to them, relying on the legal force of which they used the property, made a transaction or otherwise took advantage of the benefits and advantages provided, in case of

subsequent recognition of this act as invalid or its cancellation;

➢ withdrawal of land plots for state and public needs is allowed only after an open discussion with interested parties (investors) [8];

➢ withdrawal of land plots is allowed after full compensation of the market value of real estate and losses caused to owners in connection with such withdrawal, except for the needs of the state and society, defense and state security, protected natural areas, the creation and operation of free economic zones;

➢ long-term lease of non-agricultural land for up to 50 years is allowed for the implementation of investment projects;

➢ the minimum size of the share of foreign investments in the authorized capital of an enterprise with foreign investments has been reduced from 30 to 15 percent [9];

➢ the minimum size of the authorized capital of an enterprise with foreign investment has been reduced from 600 million to 400 million sums;

➢ the size of the state duty for the state registration of enterprises with foreign investment has been reduced by three times;

➢ measures are envisaged to attract foreign investment through the organization of international conferences, seminars, major investment forums to widely inform foreign investors about the economic potential of the country, created favorable conditions for doing business [10];

➢ granted the right to foreign citizens and stateless persons who have invested in Uzbekistan in the amount of at least 8,500 times the minimum wage - to receive a multiple-entry three-year visa with the possibility of an unlimited number of extensions of its validity without the need to leave the territory of the Republic of Uzbekistan [11];

➢ the heads of the complexes of the Cabinet of Ministers, ministries,

departments and business associations are personally responsible for the effective implementation of the decisions taken and other privileges.

Disscussion. Against this background, almost all regions of the republic need to implement investment projects that can improve the situation on the ground. [12, 13].

At the regional level, the main directions for attracting foreign capital at the present stage of economic development are:

➢ agriculture (farms). In particular, these are areas where new methods of cultivating the land can be introduced to increase fertility and efficient use, while phasing out outdated methods of sowing cotton and other crops [14];

➢ organization of production of light goods, food industry, printing, medical equipment. Along with foreign capital, the active attraction of domestic private capital and their symbiosis can accelerate the economic growth of these areas;

➢ organization of production of plastic bags and films. There is an increased demand for these products in the consumer market;

➢ production of modern energy-saving technologies, ranging from fluorescent lamps to «LED» technologies. Here, too, the demand for these products is very high [15];

➢ procurement, packaging and delivery of export-oriented fruits and vegetables to foreign markets. For a foreign investor, the return of his capital investments in the implementation of this type of project can be guaranteed as soon as possible and in US dollars;

➢ development of fish farming, poultry farming, animal husbandry. The liquidity of these types of products is very high. If highly efficient innovative technologies are introduced into these areas, then we can talk about the low cost of the final (finished) product. At the same time, waste-free and completed production can be organized in this area;

➤ construction of modern greenhouse complexes. Organization of lemonariums and mulberry plantations. The possibility of providing the local population with fresh vegetables and fruits all year round, as well as organizing their export to neighboring countries [16];

➤ development of potato seed production. This area for the Republic of Uzbekistan and for the countries of Central Asia is very relevant and the implementation of projects in this new industry seems to be quite promising;

➤ accounting and improvement of electricity, natural gas and drinking water supplies. Manufacture of meters and means of transportation of energy and drinking resources. The priority direction is their automation. In this area, it is possible to organize a network of liquefied gas supplies and subsequent maintenance. With the favorable implementation of this project and the agreement of the governments of neighboring countries, the organization of a similar project on their territory - including from the supply of a gas cylinder to gas equipment [17, 18];

➤ construction of medical-sanatorium-tourist complexes. Simultaneously treatment and acquaintance with the sights of the region;

➤ construction and subsequent joint operation of the infrastructure of housing and communal services [19].

During the development of measures, it is necessary to ensure the openness and accessibility of the heads of public authorities and administration, information services, official websites, the availability of providing information using technical means, stands and other important issues for the investor [20].

In addition, the inflow of private local and foreign capital into the country is hampered by political instability, inflation, imperfection of legislation, underdevelopment of industrial and social infrastructure, insufficient information support.

Conclusions. Thus, an effective investment policy is developed based on the specifics of the country, taking into account the problems noted above that impede foreign investment.

The implementation of the above directions will not only create jobs, but also relieve economic tensions and, of course, save significant financial and material resources.

The investment policy developed in accordance with the «Action Strategy for the Five Priority Directions of Development of the Republic of Uzbekistan in 2017 - 2021» and the logical continuation of this program «Strategy of New Uzbekistan» form a favorable environment conducive to attracting and increasing the efficiency of the use of investment resources for the development of the economy and social environment.

References

1. State economic policy. [Electronic resource]. URL: https://economics.studio/ekonomiki-regulirovanie-gosudarstvennoe/ (Date of the application: 10.04.2019).

2. Decree of the President of the Republic of Uzbekistan dated July 17, 2017 No. UP-5115 - SZ RU, 2017 «On the strategy of action for the further development of the Republic of Uzbekistan» // National database of legislation of the Republic of Uzbekistan. [Electronic resource]. URL: http://lex.uz/docs. (Date of the application: 10.10.2020).

3. Mirziyoyev Sh. Strategy of New Uzbekistan. Tashkent: «O'zbekiston» nashriyoti, 2021. 464 pp.

4. Kenneth E. Kendall and Julie E. Kendall (2014) Systems Analysis and Design. Pearson Education Limited, Edinburgh Gate, Harlow. Essex CM20 2JE. England. pp. 546.

5.	Devyatlovsky D.N. The problem of attracting foreign investment in the Russian economy // Modern science-intensive technologies. 2012. № 7. 46–47 pp.

6.	Law of the Republic of Uzbekistan «On investments and investment activities» No ZRU-598 of December 25, 2019 [Electronic resource]. National database of legislation of the Republic of Uzbekistan. URL: http://lex.uz/docs/4664144. (Date of the application: 12.01.2023).

7.	Decree of the President of the Republic of Uzbekistan «On measures to radically improve the investment climate in the Republic of Uzbekistan» dated August 1, 2018 [Electronic resource]. Official website of the national news agency «UzA». URL: http://uza.uz/ru/documents/ (Date of the application: 19.11.2020).

8.	Law of the Republic of Uzbekistan «On procedures for the withdrawal of land plots for public needs with compensation» No. ZRU-781 dated June 29, 2022 [Electronic resource]. National database of legislation of the Republic of Uzbekistan. URL: http://lex.uz/ru/docs/6087438. (Date of the application: 10.01.2023).

9.	Convincing steps towards development. [Electronic resource]. Official website of the newspaper «Narodnoye Slovo». URL: http://xs.uz/ru/post/ubeditelnye-shagi-na-puti-razvitiya. (Date of the application: 10.01.2023).

10.	Narzullaev K.S. Foreign investments: problems of attracting them to the regional economy // Scientific review. Economic Sciences. - 2018. - № 4. 16-20 pp;

11.	Decree of the President of the Republic of Uzbekistan «On additional measures for the accelerated development of tourism in the Republic of Uzbekistan» No. UP-5611 dated January 5, 2019 [Electronic resource]. National database of legislation of the Republic of Uzbekistan. URL: http:// lex.uz/m/acts/ 4562380#4563235. (Date of the application: 11.01.2023).

12.	Narzullaev K. Foreign investments: problems of attraction to the regional economy. Publishing house «LAP Lambert Academic Publishing». International Book Market Service Ltd. Brivibasgatve 197, LV-1039, Riga, Latvia, European Union, 2019. 308 p.

13.	Narzullaev K. State economic policy in the context of the COVID-19 pandemic. FarPI «Ilmiy - tekhnika zhurnali». 2022. Volume 26. № 3.

14.	Materials of the international scientific-practical conference «Ecological aspects of land use in modern economic formations». May 24, 2017, Volgograd. - Volgograd: Volgograd State Agrarian University, 2017. 508 p.

15.	LED lamps: technical solutions and trends. [Electronic resource]. URL: http:// marketelectro.ru/node/svetodiodnye-svetilniki-tekhni-cheskie-resheniya-i-trendy. (Date of the application: 09.01.2023).

16.	Decree of the President of the Republic of Uzbekistan «On measures to create modern greenhouse farms in the regions on the basis of public-private partnership» No. PP-5138 dated June 7, 2021 [Electronic resource]. National database of legislation of the Republic of Uzbekistan. URL: http://lex.uz/ru/docs/5446732. (Date of the application: 08.01.2023).

17.	Situational Analysis and Stabilization Priorities for the Development of Drinking Water Supply. [Electronic resource]. URL: http://review.uz/post/situacionny-analiz-i-prioritet-stabilizacii-razvitiya-pitevogo-vodosnabjeniya. (Date of the application: 10.01.2023).

18.	In-depth review of the policy of the Republic of Uzbekistan in the field of energy efficiency. (2022). Energy Charter Secretariat, 2022. 46 Woluwe Boulevard. B-1200 Brussels, Belgium. 219 p.

19. Klimenkov G.V. Organization of a management system for the development of the housing and communal services sector. // Vestnik UGUES. The science. Education. Economy. Series: Economy. No. 1 (7), 2014. 156-164 pp.

20. Shidov A.Kh. Regional aspects of innovation and investment development: theory and practice of investment analysis. SPb.: SPb GUEF, 2000. 158 pp.

STATISTICAL ANALYSIS OF ASSESSMENT OF THE VOLUME OF THE HIDDEN ECONOMY IN THE REPUBLIC OF UZBEKISTAN

IRISMATOV KHUMOYUNMIRZA

Doctoral student of the Institute of Personnel Training and Statistical Research under the State Statistics Committee

Annotation. This article examines the content and state of the hidden economy in our country, statistical methods used to assess its size. Measures to reduce the share of the hidden economy in our country as much as possible are also explained.

Keywords. hidden economy, hidden economy volume, white collar, gray hidden economy, indirect methods, direct methods, integration method, balance method.

It is no secret that there is a hidden economy in almost all countries of the world, and its share varies from country to country.

The attitude of scientists to the hidden economy is also different.

Some criticize it negatively, accusing it of having a negative impact on economic development, managing the state economy, of forming the basis of criminal activity, others admit that it is the foundation of new areas of the economy and innovation, first secretly, and then officially.

The secret economy is a complex socio-economic reality, which includes not only economic social structures, economic interaction in society, but, above all, the satisfaction of personal and group interests of individuals who make up part of the country's population, which cannot be controlled by society, then there is a large amount of additional income (profit) - this is the criminal use of state and non-state property, as well as economic wealth and entrepreneurial ability, hiding it from the management and control of state bodies. It is closely related to the open formal economy and is an integral part of it. Each secret activity is completely different.

Therefore, to solve the problems of the hidden economy, it is necessary to indicate its main directions and segments.

The shadow economy refers to economic activity that develops outside of state accounting and control and therefore is not reflected in official statistics. The scale and nature of activities in the shadow economy vary widely, from large proceeds of crime (such as drug trafficking) to "rewarding" a plumber with a bottle of vodka for a repaired faucet. Different types of covert activities vary in quality.

The main directions of the hidden economy. Three criteria are used to identify types of secret activities: their connection with the "white" ("first", official) economy and subjects and objects of economic activity. From this point of view, the hidden economy can be divided into three sectors (Table 1):

– "second" ("white collar"),
– "gray" ("unofficial");
– "black" ("secret") hidden economy.

Although the study and analysis of the hidden economy has been going on for about half a century, scientists and analysts still do not have a unified approach to its analysis. For example, in English-language sources one can come across such terms as "informal economy", "shadow economy", "shadow economy",

"black economy", and these terms have different meanings for different researchers. The "second" shadow economy is the illegal economic activity of workers and employees of the "white" economy at their jobs, which leads to a hidden redistribution of the previously created national income. This type of underground economy is called "white-collar" because these activities are mainly carried out by "good people" ("white-collar workers") in the management staff.

Table 1

Criteria for differentiating the hidden economy[1]

Key Features	Second Hidden Economy	Gray Hidden Economy	Black Hidden Economy
Items	Leaders of the official ("white") sector of the economy	Informal reservations	Professional criminals
Objects	Redistribution of income without production	Production of ordinary goods and services	Production of prohibited and scarce goods and services
Connection with the "white" economy	"White" is inseparable from the economy	Relatively free	"White" is autonomous in relation to the economy

There are as many ways to measure the shadow economy as there are definitions. Approaches such as Mauren (2003) and Schneider (2002) are worth mentioning. In general, all methods can be divided into two parts:

− direct methods, i.e. micro-approaches

− methods based on the choice of taxpayers, that is, indicating the development of the hidden economy in a certain period.

direct methods. These are microeconomic approaches that use well-designed surveys and sampling based on voluntary responses or tax audits and other compliance methods.

Sample surveys are widely used to estimate the hidden economy [2].

Shadow economy estimates can also be based on discrepancies between income reported for tax purposes and income measured by spot checks. In this regard, financial audit programs are particularly effective. Since these programs are designed to measure the amount of undeclared taxable income, they can also be used to calculate the size of the shadow economy. However, this approach is associated with a number of difficulties. First, using data on tax compliance is equivalent to using a (possibly biased) sample of the population [3]. In general, the selection of taxpayers for tax audits is not carried out randomly, but on the basis of characteristics of submitted (tax) returns that indicate a certain likelihood of tax fraud.

Therefore, such a sample is not random for the entire population, and estimates of the hidden economy based on a binary sample may be inaccurate. Second, estimates based on tax audits reflect only the part of the shadow economy that has been identified by the tax authorities, and this may represent only a fraction of all hidden income.

The country is implementing large-scale reforms aimed at creating favorable conditions for doing business and improving the investment climate in the areas of monetary, foreign exchange, tax and foreign trade policy.

At the same time, expert assessments and surveys conducted among business entities indicate that the hidden turnover in the economy remains at a high level, especially in such areas as trade and public catering, road transport, housing construction and repairs, and the provision of housing services. which makes the economic activities of conscientious entrepreneurs infringing on their interests, creating unequal conditions for doing business for them.

It is noteworthy that in order to reduce the level of the hidden economy in our country, conduct business activities, including the creation of equal conditions for competition by reducing the regulatory and administrative burden, and automate procedures for complying with tax laws. and to simplify its procedure [4] it should be noted that the following tasks were defined:

a) introduction of the procedure for non-inclusion of income received from individuals using bank cards and contactless payments of small businesses in the field of public catering, in order to implement the mandatory payment of general taxes;

b) reduction of the turnover tax rate from 25% to 13% for persons operating in the field of real estate;

c) allow construction companies to hire workers on a temporary basis without concluding an agreement with the right to pay wages in cash in an amount not exceeding 10 percent of the total wage fund for the reporting period (excluding the amount of social tax). In that:

d) construction organizations ensure the payment of income tax and social tax collected from individuals in accordance with the established procedure, and also submit their register to the state tax authorities indicating the amount of money paid to employees hired without a contract on a monthly basis;

e) bodies of the state tax service carry out automatic identification of taxpayers on the basis of registers provided by construction organizations, and ensure the accounting of income tax and social tax collected from paid individuals.

f) implementation of the norms of the legislation providing for social protection of workers in case of accidents at work, to persons hired without concluding a contract;

g) implementation of measures aimed at improving the efficiency of ministries and departments in the fight against the shadow economy and corruption, the development of a "road map" to improve tax and customs administration, etc.

In many countries, especially in Uzbekistan, the methods of statistical assessment of the hidden economy allow choosing specific approaches, tools and methods for calculating indicators that reflect various aspects of the hidden economy [5]. Currently, there are no standard, universal approaches that ensure the success of such a calculation in any economy. Of course, it is impossible to obtain direct and 100% statistical certainty in assessing the scale of the hidden economy.

The result largely depends on the qualifications of the appraisers and their opportunities to obtain additional information.

Researchers who determine the parameters of the hidden economy themselves often consider them indicative and give only the most general idea of the phenomenon. This is explained, firstly, by the specifics of the hidden economy, which, by definition, is hidden from accounting, control and registration, that is, from any observation, and secondly, by the probabilistic nature of most of the methods used for calculating [6].

In recent years, methods for assessing the hidden economy in world practice have received significant development. Many methods can be divided into direct and indirect. Direct methods of covert accounting provide detailed and qualitative information and are based on the results of various types of surveys (households, labor force, etc.) and

tax audits.

Sample surveys are widely used to measure both the size of the shadow economy as a whole and its individual components. The results of such surveys depend on how the questions are worded. Well-designed interview questions allow people to overcome the desire to hide their participation in hidden economic processes. Questions are asked in such a way that the interviewer does not understand the true purpose of the study.

This approach is also successfully used by the Statistical Committee of Uzbekistan, which focuses on the study of labor costs and hours worked when estimating the size of the shadow economy.

Balance methods are the most common in determining the parameters of hidden and informal economic activity and are based on a comparison of a number of interrelated indicators - income and expenses; resources and use.

The inconsistency method associated with balance sheet methods is based on a comparison of data sources and statistical documents. The residual method can be used to calculate hidden turnover, which reflects the sale of goods and services on the unorganized market by unknown enterprises and individuals.

A method based on examining the difference between total income consumed and the alternative implied income produced is reconstructed on the basis of tax paid data or value added data produced. This method is relatively simple, but has serious drawbacks. Firstly, the difference between income produced and consumed can be related to many factors, not only related to the existence of the shadow economy and the income received from its activities [7]. For example, the calculation of income generated and the calculation of costs associated with the efficiency of tax services are also very complex. Second, black market purchases by official and underground entities are excluded from the analysis, unless they are included in the cost calculation with a special adjustment. Thirdly, in such calculations it is impossible to determine the origin of income that is spent more than is produced. It remains unclear whether the income was legitimate but unaccounted for due to weaknesses in the methodology used, or whether it was undeclared and derived from criminal activities, or whether it came from savings funds and various forms of savings.
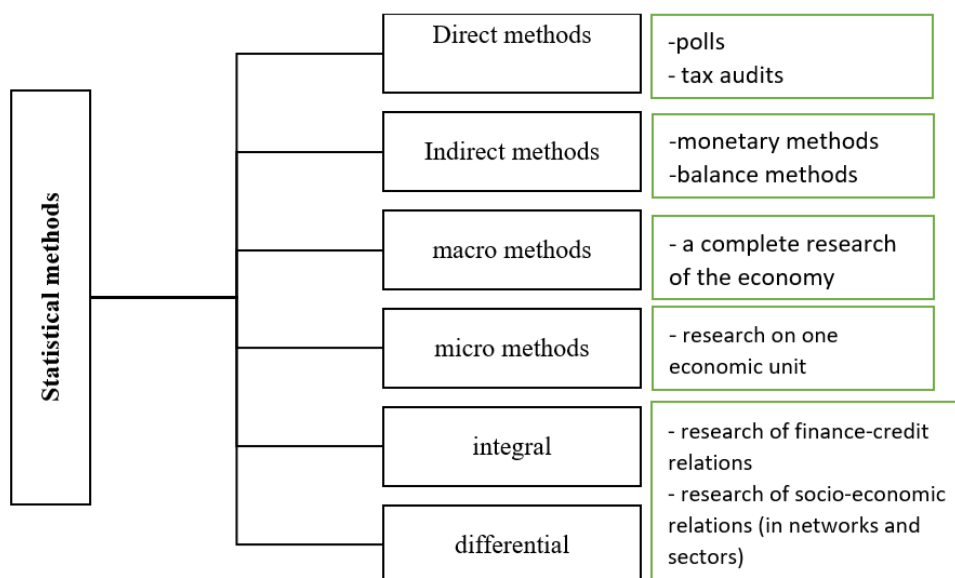
Figure 1. Statistical methods of estimating the size of the hidden economy in the Republic of Uzbekistan

Thus, the above analysis of existing methods of measuring the hidden economy shows that the national statistics service has the ability to measure the size of the unobserved economy. The public can be assured of the adequacy of the assessments offered and the impartiality of the methods used. At the same time, the main task of official statistics is to improve the methodology of statistical monitoring and calculation of indicators, as well as to find the most effective methods of obtaining representative data on hidden economic activity.

References

[1] Латов Ю.В., Ковалев С.Н. Теневая экономика: Учебное пособие для вузов. / Под. ред. д.п.н., д.ю.н., проф. В.Я.Кикотя; д.э.н., проф. Г.М.Казиахмедова. – М.: «Норма», 2006. -С. 15.

[2] Bhattacharyya, D.K. (1999), On the economic rationale of estimating the hidden economy, Economic Journal, 109, pp. 348–359.

[3] Tanzi, V. (1999), Uses and Abuses of Estimates of the Underground Economy, Economic Journal, 109/3, pp. 338–347.

[4] Ўзбекистон Республикаси Президентининг 30.10.2020 й. ПФ-6098-сон "Яширин иқтисодиётни қисқартириш ва солиқ органлари фаолияти самарадорлигини ошириш бўйича ташкилий чора-тадбирлар тўғрисида"ги Фармони.

[5] Williams, C.C. and J. Windebank (1995), Black market work in the European Community: peripheral work for peripheral localities? International Journal of Urban and Regional Research, 19, pp. 23–39.

[6] Schneider, F. (2003), The shadow economy, in: Rowley, C.K. and F. Schneider (eds.), Encyclopedia of Public Choice, Kluwer Academic Publishers, Dordrecht.

[7] Lackó, M. (2000b), Hidden Economy – an Unknown Quantity? Comparative Analysis of Hidden Economies in Transition Economies, 1989–95, Economics of Transition, 8/1, pp. 117–149.

C O N T E N T S

"SCIENTIFIC AND TECHNICHNICAL JOURNAL OF NAMANGAN INSTITUTE OF ENGINEERING AND TECHNOLOGY"

**The editorial was typed and paginated in the computer center
Paper format A4. Size 21,06 conditional printing plate**

The copy must be taken from the "Scientific and Technical Journal of the Namangan Institute of Engineering and Technology"